Whole-school Strategies to Improve Learning and Reduce Children's Stress Symptoms: Effects in an Earthquake-Struck City

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WHOLE-SCHOOL STRATEGIES TO IMPROVE LEARNING AND REDUCE CHILDREN'S STRESS SYMPTOMS: EFFECTS IN AN EARTHQUAKE-STRUCK CITY

Summary

Background: Exposure to natural disasters and other adverse events may negatively impact child mental health and cause post-traumatic stress disorder (PTSD) symptoms expressed in problem behaviour, low self-regulation, poor attitude to learning and difficulties with reading, writing and math. Long term health problems, school absenteeism, substance abuse and suicide ideation may occur in those with persistently high symptoms. Christchurch, New Zealand, has been hit by a series of thousands of earthquakes, beginning in September, 2010, which have severely affected the city, and the community's children. **Scope and objective**: Four studies were completed in 44 educational organisations for children aged 2-13, with 2,493 children assessed. Baseline studies established high rates of post-traumatic stress symptoms in children starting school post-earthquakes as compared to pre-earthquake rates in a comparable group of children. High PTS symptom rates continued during the early years of school. Beginning in 2016, an innovative set of strategies addressing neurobiological correlates of stress were implemented to improve children's wellbeing in five schools over three years. Strategy implementation was replicated in a second set of 12 schools, 12 preschools and 6 kindergartens over 2017-2018. Effects of the strategies were studied longitudinally between 2016-2018. Overall, the schools, preschools and kindergartens that implemented the strategies enrolled more than 5,700 children, and effects were contrasted with 2219 children in schools that did not implement the strategies. **Findings:** Strategies effectively reduced PTSD symptoms in the worst affected school children (Cohen's d effect size =1.23), kindergarten children (d= 1.61) and preschool children (d= 2.24) in one year, with better results after three years. Self-regulation, attitude to learning and meeting achievement standards improved. Effects were similar across low-, mid- and high decile schools, boys and girls, and children of priority ethnicity. Schools and preschools which did not implement strategies saw children's symptoms worsen. **Recommendation:** Preschools, kindergartens and schools can reduce the number of children with high levels of stress symptoms and the overall level of stress symptoms. This can benefit the children, their families, schools and community. We want to prioritise using the strategies to reduce PTSD symptoms because these are serious, the risk of future mental health problems is high if the symptoms are not treated, and the treatment is cheap and low risk.

Dedication

Children, principals, teachers and parents

Our families

Our community

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Whole-School Strategies to Improve Learning by Reducing Children's Stress Symptoms

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CHAPTER 1. INTRODUCTION

This report describes four studies conducted primarily on the east side of Christchurch during the past twelve years:

1. A study of 298 five-year old children's mental and physical health as they entered schools in 2006 and 2007,
2. A study of 308 five-year old children's mental and physical health and early learning as they entered schools in late 2012 through 2015.
3. A study of 360 children's (years 1-3) post-traumatic stress symptoms, self-regulation and learning as schools trialled strategies (or did not trial strategies).
4. A study of 1170 children (years kindergarten-8) post-traumatic stress symptoms, self-regulation and learning as schools trialled strategies (or did not trial strategies).

In addition, a literature review of events affecting the mental health of children, families, communities and schools previews the studies, and informs discussion of the findings.

The purpose on the Strategies Project was to reduce the symptoms of post-traumatic stress disorder documented in an earlier study (Liberty et al., 2016) in the children who had been exposed to the earthquake sequence between September 2010 and June 2012 (and continuing) using innovative strategies to address the neurobiological basis of symptomatic behaviours and health problems.

While the strategies were planned, school-led choices on whether a specific strategy was adopted or not, and how a strategy was implemented (or not) meant that there were variations in strategy implementation. This variation strengthened the study findings because variations in results could be systematically explored, and met some of the criteria of a "natural experiment' (Bor, 2016).

Studies of strategy implementation in post-disaster communities often target children with the highest level of PTSD symptoms (e.g., Goldman et al., 2015), because these are children with the highest level of need. In our studies, there are two principal outcomes of the impact of the strategies on children's PTSD symptoms. One is the impact on children with a clinically high

level of PTS symptoms, and the other is the impact on other children, including those with sub-clinical-levels of PTS or with zero symptoms.[1]

Finally, while the overall aim of the project was the reduction of PTSD symptoms, this was only the indicator outcome, because a cascade of effects was hypothesised. First, reduction of PTS symptoms would produce calmer classrooms. Next, calmer classrooms would permit teachers to engage in more prosocial and or learning-focused interactions with children and fewer interactions to manage problem and off-task behaviours, which is why RIRO strategies were introduced at the second year. It was further hypothesised that calmer classrooms and more positive teacher-pupil interactions would result in improvements in learning. As learning improved, children would be better self-regulated, and able to learn coping strategies, such as sleep hygiene and positive coping. These, in turn, would improve their sleep and then their memory for learning. Finally, after three years, it was hypothesised that improvements in positive behaviours, particularly those associated with self-regulation, would be evident.

Adverse Childhood Experiences (ACES)

Individuals accumulate encounters with stressful events over the lifespan. It is the accumulation of stressful events that is associated both with the persistence of post-traumatic stress, the difficulty of treating it, and the increasing prevalence by age (Furr, Comer, Edmunds, & Kendall, 2010).

As children grow up, they accumulate experiences of potentially traumatic events, including the following events which were first identified as risk factors for poorer developmental outcomes if they occurred before age eighteen:

a. Lived with a parent or caregiver who was divorced or separated?
b. Lived with a parent or caregiver who died?
c. Lived with a parent or caregiver who served time in prison?
d. Lived with anyone who was mentally ill or suicidal or severely depressed for more than a couple of weeks?
e. Lived with anyone who had a problem with alcohol or drugs?
f. Witnessed a parent, caregiver or other adult in the household behaving violently toward another (for example slapping, hitting, kicking, punching or beating each other up)?
g. Been the victim of violence or witnessed any violence in your neighbourhood?

h. Experienced economic hardship somewhat often or very often (i.e., the family found it hard to cover the costs of food and housing)?

Initially, it was hypothesised that certain risk factors had greater 'impact-weight' in affecting outcomes, but recent research indicates that negative outcomes are associated with the cumulative impact of events, rather than any one particular event. Experiencing a traumatic event does not inevitably lead to negative mental health, school, or physical outcomes, however, each traumatic event can accumulate effects, similar to adding straw to the "camel's back" until the "final straw" breaks the camel's back.

In addition, since the original ACES studies twenty years ago, additional events, such as experiencing a natural disaster, have been identified as conveying the similar impacts on the accumulation of trauma (Chronholm et al, 2015; Mersky et al, 2017). Generally, adverse events convey biological reactivity to experiences of threat and experiences of deprivation (McLaughlin, 2017), which include the dysregulation of the nervous system (Elbers et al., 2017). For instance, the *Child PTSD Checklist* (Scheeringa, 2012) for children aged 1-6 years includes the following criterion.

"Events must have been witnessed by the child, and led to serious injury to the child or another person, usually someone the child loves, or be perceived by the child as if it could have led to serious injury."

- Accident or crash (automobile, boat, plane),
- Attacked by an animal,
- Human-made disasters (war, terrorism),
- Natural disasters (hurricane, flood, tornado),
- Hospitalization or invasive medical procedures,
- Physical abuse,
- Sexual abuse, sexual assault or rape,
- Accidental burning,
- Near drowning,
- Witnessed another person being beaten, raped, threatened with serious harm, shot at, seriously wounded, or killed, or
- Kidnapped.

The Adverse Experiences in Childhood (ACE) studies indicate that experiencing 4 or adverse experiences puts the individual in a high-risk category for negative mental and physical health outcomes in adulthood (Hughes et al, 2017). Children who have experienced three or more ACES in early childhood may show effects on their learning and behaviour in childhood and adolescence (Dunn et al., 2019; Hunt, Slack & Berger, 2017).

It is estimated that between 26%-50% of children in the USA have experienced one ACE, and about 15% have experienced three or more by the time of adolescence (Harris, Marques, Oh, Bucci, & Cloutier, 2017; Moore, Sacks, Bandy & Murphey, 2011).

An Adverse Childhood Event Study conducted in Washington State included 2100 randomly selected children from ten primary schools in kindergarten through grade six (about ages 6-12 years). This study showed a relationship between experiencing three or more adverse experiences and frequent absence from school (6 times more likely), academic failure (3 times more likely), and high behaviour problems (6 times more likely).

These problems seem to continue into adolescence. Moore et al. (2014) reported that 15.4% of adolescents in a sample of more than 95,600 who were interviewed, had experienced 3 or more ACES. Of those who had experienced three or more, 49% failed to finish tasks they started, 48% had low school engagement, 41% had high levels of externalising behaviour problems, and 44% were not able to stay calm, among other problems.

Experiencing three adverse events prior to adolescence is associated with many adjustment problems that can affect learning, self-regulation of behaviour, and family relationships. Extended family poverty and food insecurity are adverse events that increase the risk for traumatic effects, and research has identified that families living in poverty are more likely to experience multiple adverse events (Bruner, 2017).

ACES in New Zealand

Recent New Zealand research by Walsh and colleagues (2019) has identified similar results; using data from the Growing Up in New Zealand Study, researchers reported that 29.8% of children had experienced one ACE before entering school at four and one-half years of age Child emotional abuse was the most common ACE (Table 1). Overall, 14.5% had experienced two ACES, 6% had experienced three ACES and 2.6% had experienced four or more ACES before starting school. There was a direct negative linear relationship between the

number of ACES experienced and measures of school readiness (Walsh, Joyce, Maloney, & Vaithianathan, 2019).

Table 1 Percentage of New Zealand children experiencing Adverse Childhood Experiences (ACES) by age 54 months (Walsh, Joyce, Maloney, & Vaithianathan, 2019).

*GUiNZ is an acronym for the study name, "Growing Up in New Zealand."

Adverse childhood experience (ACE)	**Percent of GUiNZ children experiencing ACE**	**Number of GUiNZ children experiencing ACE by 54 months**
Child emotional abuse indicator	23.6%	1,310
Child physical abuse indicator	19.8%	1,101
Parent or partner indicator for illegal street drugs use	10.8%	601
Parent or partner indicator for depression	10.5%	584
Parent separation or divorce indicator	10.2%	569
Parent or partner intimate violence indicator	6.6%	366
Parent or partner indicator for problem drinker or alcoholic	4.5%	249
Parent or partner indicator for conviction and jail time	1.8%	99
Total adverse childhood experiences		
0	47.2%	2,624
1	29.8%	1,657
2	14.5%	804
3	6.0%	334
4 or more	2.6%	143

However, researchers in New Zealand have questioned the contextual relevance of ACEs for bicultural Aotearoa New Zealand, as the impacts of racism, colonialism, and poverty are not considered in the usual method of ACE assessment used in the USA (Atwool, 2019; Joy & Beddoe, 2019). Recent research has identified events other than the original eight ACEs as having the risk of negatively affecting mental health, such as living in foster care, experiencing racial discrimination, peer victimisation and witnessing violence in the community, especially as they affect minority populations (Cronholm, 2019).

Earthquakes as an Adverse Childhood Event Leading to PTSD

Earthquakes themselves are an adverse event that is associated with the onset of Post-traumatic Stress Disorder (PTSD) and Post-traumatic Stress Symptoms (Earthquakes are also associated

with the risk of increased numbers of additional adverse events affecting children, including injury, death of a loved one, hospitalisation, parental separation, house damage or loss and moving, high family stress, changes in parental employment, school closures and mergers and general community disruption. In post-disaster studies, it is impossible to statistically separate the effects of earthquakes from the adverse events that follow.

Not only is PTSD associated with experiencing multiple ACES (Kessler et al, 2010), it is the most common mental health outcome of experiencing earthquakes is PTSD (Bromet, et al., 2017; Steinberg, Brymer, Decker & Pynoos, 2004).

Earthquakes and natural disasters, as well as their subsequent post-disaster environments, are known to increase adverse events, including family break-ups, loss of employment, increases in disability as well as the disruption of health, mental health, social and educational services that, in normal times, ameliorate the effects of events on individuals (Shaw, Espinel & Schultz, 2012; Shirlaw, 2014).

Map 1: Percentage of the population with a WHO-5 score less than 13 by geographic area, April 2015

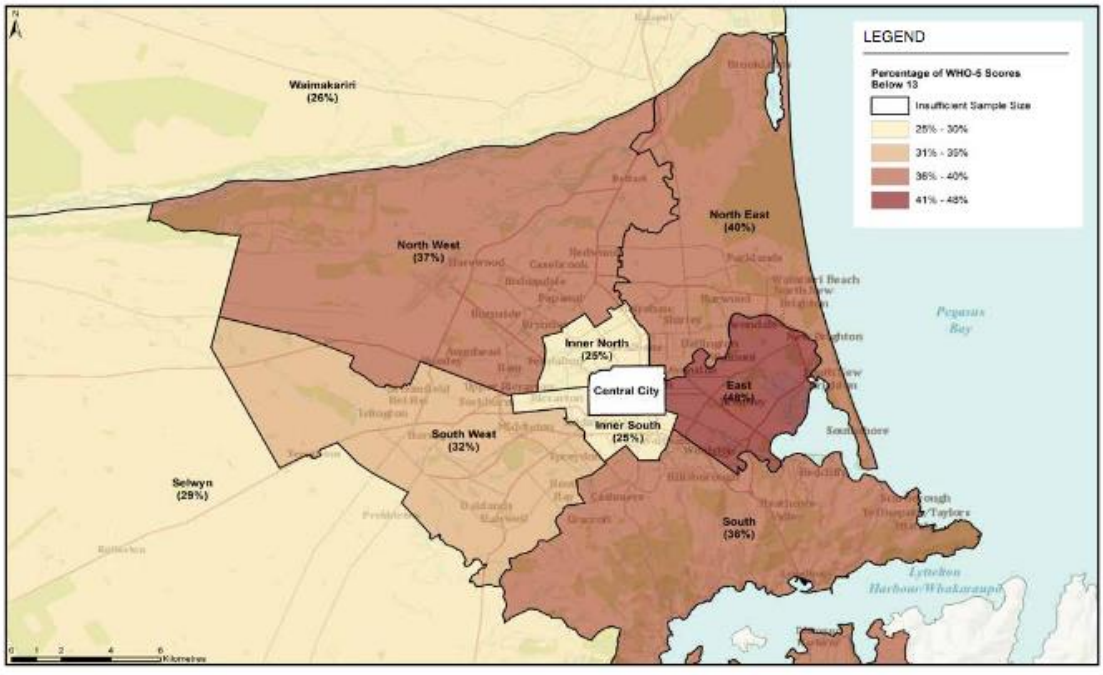

Figure 1 Percentage of population reporting significant levels of mental distress, April 2015. (CERA, 2015).

As evidence of the effect of earthquakes, during 2015, in the part of the city in which most of the study schools were located, almost half of the residents had mental health scores below the clinical cut-off, using the World Health Organisations mental health survey (Canterbury Earthquake Recovery Authority, 2015), and the other districts affected by earthquakes had lower, but still concerning, levels of 40% and 36% (Figure 1).

Such events can cause traumatic stress, which is associated with changes to brains and bodies – and traumatic stress can change our DNA expression as explained by epigenetics. Traumatic experiences in our past explain why we can have difficulties coping with stress in our present daily life. Therefore, the context of the studies in this report is one in which it would be expected that study children would have been exposed at least one ACE : earthquake exposure.

Post-traumatic Stress Disorder in Children

A significant minority of children will experience Post-traumatic Stress Disorder (PTSD) or post-traumatic stress symptoms (PTS) following a disaster (Table 2). The symptoms of this disorder may appear shortly following the disaster, or months later. Young children are particularly vulnerable to the effects of natural disasters, although out-dated beliefs that children are "naturally resilient" persist. In studies of other earthquakes, reviews of PTSD in children following earthquakes identified rates varying from 2.5% to 60%, with differences due to earthquake severity and study methods in different countries (Şalcıoğlu, & Başoğlu, 2008; Tang, Deng, Glik, Dong & Zhang, 2017). However, an additional review of 26 studies of children following earthquakes reported that none focused on young children of the ages of children in the present study (Wang, Chan & Ho, 2013).

PTSD Symptoms

Repeated exposure to potentially traumatic events is identified as Type II trauma, and this is associated with increased numbers of children with PTSD symptoms, and increased severity of symptoms. There is little longitudinal research studying children affected by natural disasters, although PTSD is known to persist into adulthood (McLaughlin, Brent & Hermann, 2019), and physiological changes in adolescents were still significant five years after an earthquake in Armenia (Pynoos, Steinberg, Ornitz & Goenjian, 1997).

The symptoms of PTSD in young children are necessarily different from symptoms in older children, due to differences in development, difficulties in distinguishing problems from

developmental patterns, and language development, for instance (DeYoung & Landolt, 2018). For example, older children may have developed coping skills, or language to describe their inner emotional and physical states which young children have not yet developed. McLaughlin, Brent and Hermann (2019, July) have an excellent evidence-based description of children's PTSD.

Table 2 Post-traumatic stress (PTS) symptoms evaluated in study participants

Symptom	PTS Symptom Scale Descriptors	DSM-5 Symptom Category
1	Overly clingy, dependent	Intrusion/distress (B-1)
2	Frequent mood changes	Intrusion/distress (B-2)
3	Anxious, fearful	Intrusion/distress (B-3)
4	Repetitive thoughts, difficulty getting mind off certain things	Intrusion/distress (B-4)
5	Unhappy, sad, depressed	Negative Cognitions (C/D-1)
6	Withdrawn, withdraws from others	Negative Cognitions (C/D-1)
7	Difficulties with concentration	Arousal (E-1)
8	High strung, restless	Arousal (E-2)
9	Irritable, stubborn, sullen, quick temper	Arousal (E-3)
10	Argues a lot, disobeys	Arousal (E-4)

Symptoms include thoughts that unexpectedly enter the child's mind and cause them to "space out", or cry out in distress or lash out so that the child's moods and reactions appear to parents, teachers and peers as unpredictable and not related to events in their current surroundings. Children may have headaches, stomach aches, scary dreams, fear going to bed, wake up in the night, and be tired during the day. Children may burst into tears, react aggressively, run away, or withdraw or cling. They may be unusually fearful of others, and negative about themselves and others, and often seem sad and to express few positive emotions. Children with PTS symptoms are likely to have difficulty concentrating, due to the uninvited thoughts, sleep and health problems, and negative appraisals of their abilities (Cintron, Salloum, Blair-Andrews, &

Storch, 2018). These symptoms may cause limitations or delays in their ability to function, which may include, for example, language delay, enuresis, and difficulties with learning, short-term memory and peer-relationships. As children experience these difficulties, their negative appraisals of self (negative cognitions are a symptom) -and others (associated with disrupted and inaccurate emotion recognition) are likely to be reinforced.

PTSD symptoms may be associated with, or precede, the development of depression and anxiety disorders, externalising disorders, substance abuse, self-harm and suicidal behaviours. Children may have symptoms similar to Anxiety and Depressive Disorders, Conduct Disorders, Attention Deficit Hyperactivity Disorder and Autism and can be misdiagnosed in the over-stressed context of post-disaster communities (Hunt, Pal, Schwartz & O'Mathúna, 2018; Kerns, Newschaffer & Berkowitz, 2015; Selwyn, Schneider, Anderson & Langhinrichsen-Rohling, 2019; Szymanski, Sapanski & Conway, 2011; Weems, 2015). As traumatic events affect some proportion of children in all communities, there will always be a baseline rate of child PTSD above zero. However, the evidence is that natural disasters increase the rate of child PTSD in a community. The next section describes a pathway that can help explain how a series of earthquakes can provoke children's development of PTSD symptoms.

Even one symptom can cause problems

Despite the emphasis on children meeting formal diagnostic criteria for PTSD, international research also indicated that even one symptom can cause serious problems in daily life (Perlman, Jones, Wakschlag, Axelson, Birmaher & Phillips, 2015). For instance, in the present study, at baseline, children with a single symptom such as irritability were significantly more likely to cheat or lie ($p<.001$), have difficulty concentrating ($p<.001$), be rated by teachers as having below-average behaviour ($p<.001$) and learning to read ($p<.001$), as compared to children with zero symptoms. Even one of these problems is associated with long-lasting negative outcomes during childhood and into adolescence. The longitudinal effects of earthquakes in a post-disaster community, and the additional burden of more community stressors were very clear by the end of 2015. Thus, it was recognised that it would require sustained effort to reduce post-traumatic stress symptoms and to assist children in improving their health and wellbeing. It was also blindingly evident that schools and teachers were suffering from stress and pressures in addition to those facing other community sectors.

Parenting AND PTS

Parenting style affects development. Parents who are controlling and authoritarian or who don't set limits and are permissive are both more likely to have children with behaviour problems (e.g., Aunola & Nurmi, 2005). In addition, children living with parents who argue and fight, abuse or neglect them, have mental health problems, are irritable and inconsistent, are anxious and/or depressed are also more likely to have children with mental health problems (Eun et al, 2018). Parenting affects child development whether or not an earthquake or other natural disaster occurs.

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Review

The role of parenting behaviors in childhood post-traumatic stress disorder: A meta-analytic review

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Highlights

- Significant associations were found between parenting behaviors and childhood PTSD.
- Parenting behavior accounted for 2.0–5.3% of the variance in child PTSD.
- Both negative and positive parenting were significantly associated with child PTSD.
- Positive and negative parenting effects did not differ statistically in magnitude.

Figure 2 Summary of findings in a review of the role of parenting in child PTSD (Williamson et al., 2017).

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Children who are living with parents who have a mental health disorder or in dysfunctional families – both ACES – before a natural disaster are at increased risk for PTSD following the disaster (Green et al., 1991; Leijdesdorff, et al., 2017). This is because their brain development is more likely to have been affected before the disaster, and pre-disaster experiences of trauma appear to increase vulnerability to developing PTSD post-earthquakes (Forresi, et al., 2019; Giannopoulou, et al., 2006). New Zealand has high rates of PTSD in adults (Karam et al.,

2014) as well as high rates of domestic violence, which can have adverse consequences on children, and many young children in New Zealand are likely to have experienced at least one ACE before starting school (as described in the previous section).

There is no evidence that a natural disaster changes parenting, so it would be expected that, generally, the child will continue to experience the same style of parenting as they experienced before the disaster, unless the parent develops PTSD or other mental health problems themselves.

Research indicates that children can exhibit PTS symptoms independent of parenting styles. Children living with supportive parents after a community disaster were not protected from developing PTSD (Green et al, 1991). Children who received physical punishment from their parents two years after the Great Japan earthquake were more likely to have mental health problems 2-4 years later, while other parental styles had no impact (Miki et al., 2019)—but harsh punishment is also associated with mental health problems even in the absence of natural disasters. A recent review reported post-disaster parenting contributed only between 2-5% of the variability in children's symptoms (Salmon, Sinclair, & Bryant, 2007; Williamson, Cresell, Fearon, Hiller, Walker & Halligan, 2017; Figure 2). An in-depth longitudinal study of parent's initial reactions to a traumatic event affecting their child that resulted in hospitalisation (e.g., automobile accident, serious fall)found no impact of the parent's initial reactions on subsequent child mental health (Hiller et al, 2018). Two recent reviews of treatments both reported that including parents in the treatment of PTSD did not have any impact on treatment outcome (Gutermann, Schwartzkopff & Steil, 2017; Morina, Koerssen, & Pollet, 2016). The lack of effect of including parents in treatment may be because parenting behaviour is not the cause of problems that are symptomatic of PTSD and because treatments tend not to address the biological roots of PTSD.

Research also shows that instead of parents causing child stress symptoms following adverse events (excluding abuse and maltreatment), the reverse is actually true, and children's PTSD symptoms cause parents worry and guilt, the children's sleep problems affect parent sleep, the children's bed wetting and reactive coping mean that parents are struggling (Cobham, McDermott, Haslam & Sanders, 2016). The carryon from this is that places of employment also suffer these effects—when parents are not able to work to their full potential.

Prevalence of PTSD in New Zealand Before the Earthquakes

New Zealanders may currently be particularly susceptible to developing PTSD following natural disasters for two reasons. First, due to the existing high rates in the adult population and, second, due to the cumulative impacts of historical trauma on a significant proportion of the adult population.

A World Health Organization Survey reported a 12-month prevalence of PTSD in 2.1% in adults—the third highest in the world—based on a data collected in 2007 (Karam et al., 2014)., and a life-time prevalence of 6.1% (highest in 27 countries (Kessler & Ustun, 2008). Between 7.1%-13.6% of New Zealand police were reported to have PTSD (Stephens & Miller 1998) and between 15-27% of Vietnam veterans from New Zealand (MacDonald, Chamberlain & Long, 1997). The Dunedin longitudinal study reported that 97 of 1037 individuals, 8.97% had PTSD at age 26 years (Koenen, Moffitt, Poulton, Martin & Caspi, 2007), and, of those exposed to severe maltreatment between the ages of 3-11, 36.4% had PTSD between the ages of 26-38 years, 23.5% of those experiencing moderate maltreatment had PTSD, and even 16% of those who did not experience any maltreatment had PTSD (Breslau, Koenen, Luo, Agnew-Blais, Swanson, Houts, Poulton & Moffitt, 2014). In a study of individuals participating in alcohol and drug outpatient services in Christchurch and Hamilton, 31% had a 12-month rate of PTSD, with a 45% lifetime prevalence, with an average age of onset of 18.6 years (Adamson, Todd, Sellman, Huriwai & Porter, 2006). In addition, adults with PTSD are likely to have their parenting affected, or to experience stressful pregnancies, and thus their children are more vulnerable to developing PTSD (Van den Bergh et al., 2017; Yehuda, Halligan & Grossman, 2001). Thus, the existing high rates of PTSD in New Zealand adults may make their children more vulnerable to developing symptoms following natural disasters.

PTSD may also develop more readily in individuals whose ancestors have experienced traumatic events (Blacker, et al, 2019), which may help to understand the high rates of PTSD in Māori, and in New Zealand (Hirini, Flett, Long & Millar, 2005). Due to greater vulnerability associated with historical trauma, as well as present vulnerability that is associated with living in poverty, Māori may be more likely to develop PTSD symptoms, as discussed by Pihama, Leonie Pihama, Paul Reynolds, Cherryl Smith, John Reid, Linda Tuhiwai Smith, and Rihi Te Nana (2014).

Earthquakes and Post-traumatic Stress Disorder

While there are many other traumatic events associated with PTSD in children, such as serious accidents, domestic violence, and maltreatment, natural disasters are different in that they impact on a large number of children at the same time. This reduces the resources available to support and help children and creates community stressors that impinge on families, schools, and agencies.

Earthquakes are also different to some of the other ACES in that some traumas that cause PTSD are associated with interpersonal relationships. For example, PTSD following from abuse, assault, neglect or maltreatment is associated with person-on-person trauma. Similarly, some disasters, like that in New York (9/11), Sandy Hook (School Shooting), Oklahoma City (Explosion at Preschool), and so forth, are also associated with what can be identified from a child's view as "bad people doing bad things". Even very young children seem to have a perception of "bad people", so explaining events to children at their level of comprehension may be somewhat easier. However, earthquakes are completely different to "bad-person" - caused events, and attribution is to forces invisible to the eye. This makes it much more difficult for even older children to understand. It is not the type of explanation for the event, or the lack of an explanation, or even narrative memories of the earthquakes that are the probable impetus for the development of PTSD symptoms in young children.

Exposure to earthquakes greatly increases the risk of post-traumatic stress disorder (PTSD) and post-traumatic stress symptoms (PTSS) in children (Kar, 2009; Overstreet, Salloum, Burch & West, 2011; Proctor, Fauchier, Oliver, Ramos, Rios & Margolin, 2007). For example, 71.6% of children aged 4-5 years had distress symptoms 8 months after the Northridge, California M6.7 earthquakes (Proctor et al 2007); 42.6% of children in grades 1-9 had probable PTSD eight months after the M9.0 Great Japan earthquakes (Usami, Iwadare, Kodaira, Wantanabe, et al., 2012); 22.9% of children aged 6-10 who lived very near the epicentre of the M5.7 L'Aquilla, Italy, earthquakes had PTSS 12-17 months later (Feo et al., 2014); 54.2% of school children had PTSD 18 months after an M6.9 earthquakes in Armenia (Goenjian, Pynoos, Steinberg, Najarian et al., 1995) and 28% of children aged 8-15 had severe or very severe PTSS 36 months after an M7.4 earthquakes in Marmara, Turkey (Eksi & Braun, 2009). A recent review of PTSD in children following earthquakes identified rates varying from 4.5% to 95%, with differences due to measurement, sampling, and earthquakes severity in different countries (Şalcıoğlu, & Başoğlu, 2008). However, an additional review of 26 studies of

children following earthquakes reported that none focused on young children (Wang, Chan & Ho, 2013).

Factors associated with the rate of PTSS following earthquakes include socioeconomic status, ethnicity, and gender, as well as the experience of other traumatic events (Furr, Comer, Edmunds & Kendall, 2010; Şalcıoğlu, & Başoğlu, 2008). The effects of earthquakes may also differ across countries, due to the availability of resources to address post-disaster conditions, including health and infrastructure capabilities, and according to the magnitude and features of the earthquakes, such as whether a tsunami was also experienced (Shaw, Espinel & Schulz, 2012).

The number of people affected by PTSS following earthquakes may reduce over time. For example, PTSD reduced from 40% of adults to 19% over two years after the 5.6 earthquakes in Newcastle, Australia (Carr, Lewin, Webster, Kenardy, et al., 1997). However, PTSS is likely to persist for years in vulnerable groups, such as low-income mothers and young children (Paxson, Fussell, Rhodes & Waters, 2012; Rhodes, Chan, Paxson, Rouse et al., 2010; Scheeringa, 2008).

The Canterbury earthquakes were not a one-off event, and the experiences of a jolting earth were repeated many thousands of times over more than five years, which means that the experiences of children living through these years is a Type II trauma. The extent and duration of the earthquakes is related to an increase in prevalence.

Between the ages of 12-60 months (the ages at which the original study children experienced the Canterbury earthquakes), children would typically progress through sensorimotor and preoperational thought, and develop trust, autonomy, and empathy as socio-emotional development. Research has shown that children younger than about seven years do not understand the concept of chance events, and often attribute intention or purpose to such events (Piaget & Inhelder, 2014). Thus, conventional explanations for earthquakes (EQ) as 'chance' or 'accidental' which are used to reassure and help older children and adolescents, cope with disasters, are unlikely to be understood or ameliorate symptoms in young children (Prinstein, et al., 1997).

Biological Changes in Young Children Associated with Earthquakes

When an earthquake strikes, there is no warning. There are no calls to evacuate or warning sirens. This means that there are no possible self-regulatory processes that an individual can evoke before the traumatic event – no way to prepare the autonomic nervous system for what is about to happen. Thus, it is improbable that parental actions can prevent the arousal the child experiences at the moment an earthquake strikes.

The child's fear response system, the Hypothalamic-Pituitary-Adrenal (HPA) axis mediates the interactions that constitute the stress response including the amygdala, the hippocampus, and the Autonomic Nervous System, is automatically activated by the sensation of the earth shaking and the accompanying noise and visual signals (Najarian & Fairbanks, 1996; Song, Zhou & Wang, 2008). It is the child's bodily proprioception of an earthquake that immediately activates the HPA axis, not anything caused by parents, or a parent's reactions at the time an earthquake struck. Children experienced more than 15,000 earthquakes and aftershocks in the Christchurch area (Geonet Science, 2014), and it is the duration of the EQ period, the number of repeated HPA activations, and the timing of these events during the sensitive periods of child development that has caused the post-traumatic stress in children. Similarly, if one puts one hand on a hot surface, there is an automatic fear reaction and a withdrawal of the hand from the surface. These are not self-regulated thinking responses, and these responses are not in reaction to parenting.

The bodily experience of fear occurs independently of and before the parent's subsequent reaction to the child's hurt or expression of fear. In the Christchurch earthquakes, this fear activation of the amygdala and the HPA axis occurred many times, and, most likely, more than 100 times. Even adults will have an initial fear reaction to earthquakes. Although the level of this activation may fade over time, it is not clear that this fading also happens in young children.

Repeated experiences of earthquake tremors (or other adverse events that cause the stress response) dysregulate the autonomic nervous system, as previously explained, and lead to PTSD, or PTS, with the symptoms expressed in children's behaviour (Agorastos et al., 2018; Elbers et al, 2017; 2018). A recent study indicated that even a twenty-minute warning could reduce the negative mental health effects of being forced to flee one's home due to flooding (Munroe et al., 2017). Such a twenty-minute warning, given via text message, news media, social media, or other media provides the opportunity to plan and establish coping strategies,

including giving the body a warning as to what is about to happen. This is complementary evidence as to the fact that earthquakes, for which no warning system yet exists, may result in higher levels of post-disaster effects.

In the case of natural disasters such as earthquakes, the disaster itself is followed by a series of events which can be traumatic in themselves, such as injury to self, death of a loved one, displacement from homes and communities, the break-up of families, loss of employment. Such adverse experiences themselves may add to the burden of the initial trauma, and increase symptoms.

A recent research study pinpointed that trauma, such as that associated with natural disasters, occurring in early childhood (or prenatally) has a high probability of affecting child behavioural development, including the development of PTS symptoms (Dunn et al., 2019).

Sleep Problems

Sleep problems are a common outcome of traumatic events, including earthquakes, and are a symptom of PTSD in young children. Research indicates that children who are having sleep difficulties are also more likely to have the following problems (Beebe, 2011; Blader, Koplewicz, Abikoff, & Foley, 1997; Kovachy, et al., 2013; Sadeh, Gruber, & Raviv, 2002; Segerstrom, Smith, & Eisenlohr-Moul, 2011):

1. develop illnesses that lead to school absences. School absences can negatively impact on children's learning and achievement.
2. struggle to concentrate during the day. Loss of concentration can reduce learning.
3. have problems with their ability to problem solve.
4. have memory deficits. Sleep is necessary for the consolidation of memory, and interrupted sleep is associated with memory deficits.
5. have poor executive function (working memory, flexible thinking and self-control).
6. have increased bias toward seeing the world in a negative light.
7. be moody, grouchy and irritable and have frequent mood changes.
8. react adversely to even minor events (meltdowns), and be
9. less likely to think before they act.

This has been demonstrated in many studies. For example, Sadeh and colleagues (2002) demonstrated that good sleepers have much better scores on all measures of child behaviour as

compared to poor sleepers, including externalising behaviour problems, aggressive and delinquent behaviours, anxiety and social problems (Figure 3). Poor sleep includes shorter or interrupted sleep duration, an inconsistent bedtime and poor sleep quality. Any or all of these impair children's ability to function to the best of their capabilities on a daily basis, and problems can accumulate over time (Cho, Quach, Anderson, Mensah, Wake & Roberts, 2015). Sleep problems can also reduce the effects of remedial learning or support programs, and affect children's memory of what they have learned (Blunden & Chervin, 2007).

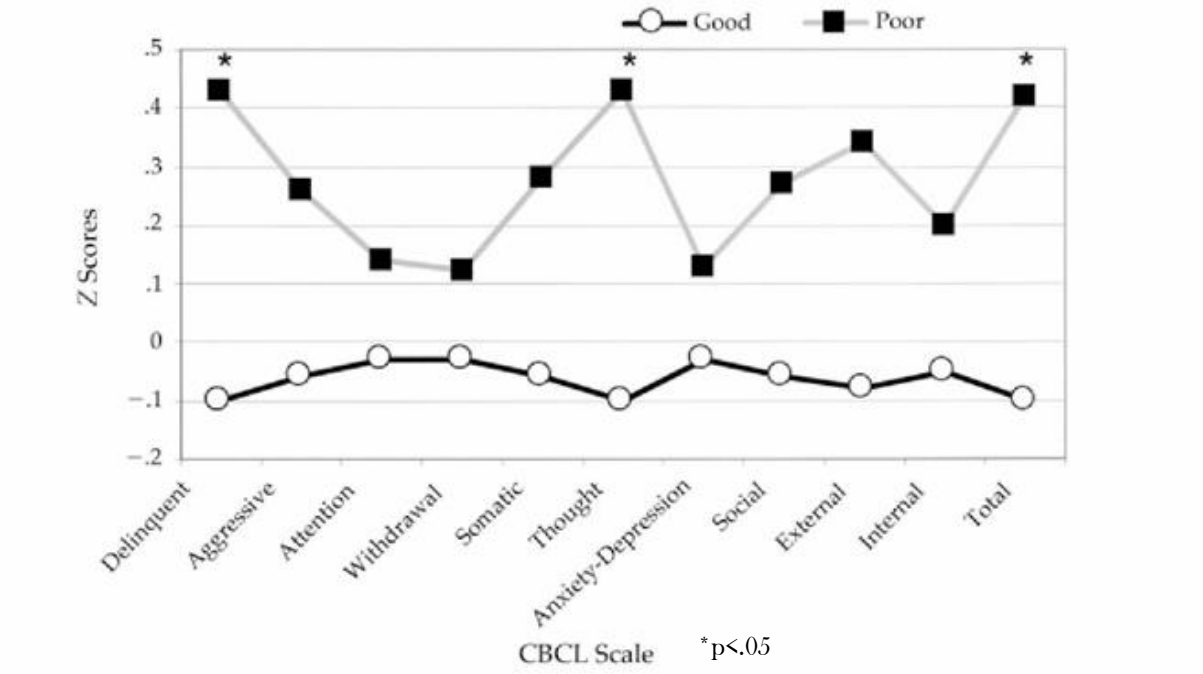

Figure 3 Behavioural differences of good (o) and poor (■) sleepers (Sadeh, Gruber & Raviv, 2002).

The association between behavioural problems and the quality of children's sleep is a key to the wellbeing of children with PTS symptoms, because the behavioural problems are similar to the symptoms of PTS.

Children's Post-traumatic Stress Symptoms 2006-2018

This study measured post-traumatic stress symptoms, learning and positive behaviours related to resilience (further details in Chapter 4).

Children were assessed using measures identical to a study of children's health that was conducted in the same neighbourhoods four years before the start of the earthquakes.

Our pre-earthquake study (i.e., Study 1) identified rates of PTS for five-year old children entering school in 2006 and 2007 from this study are shown in Figure 4, and average about 8% (further details in Chapters 3 and 4). Our study (i.e. Study 2) of children' who were younger than 42 months of age at the start of the earthquake sequence was initiated in 2012 (Liberty, et al. 2016). As shown in Figure 4, rates of PTS symptoms in five-year-old children have increased beginning in 2013 when the age cohort who experienced the earthquakes before the age of 42 months started school (marked with an asterisk in Figure 4). The increased rate of PTS symptoms in the population continued through 2018.

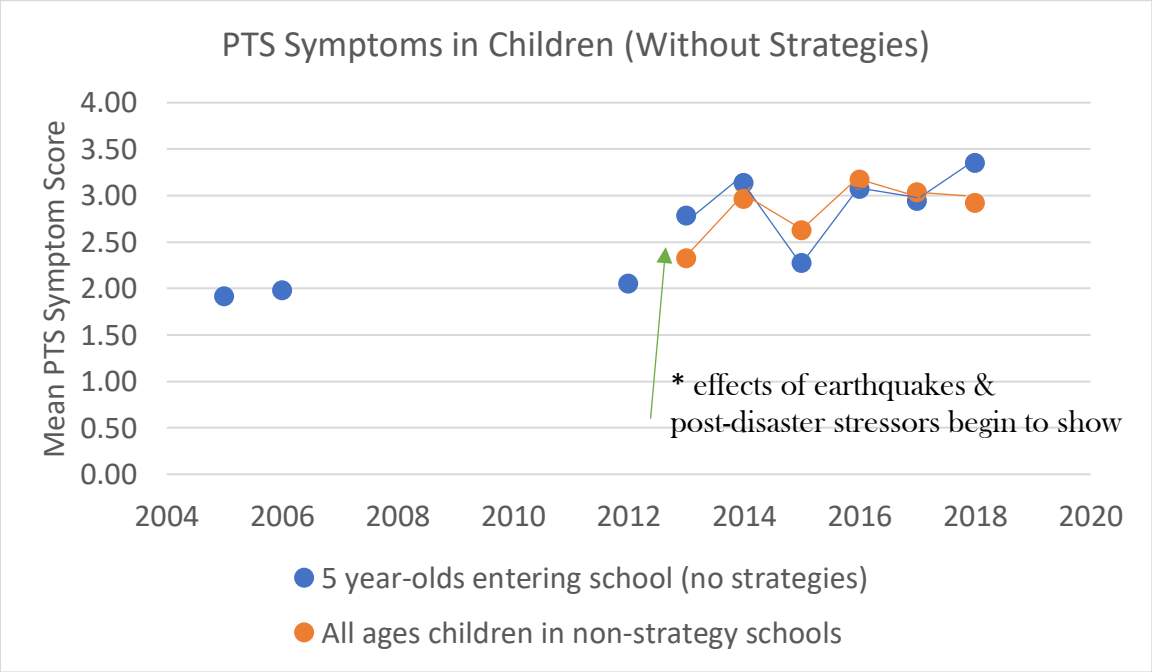

Figure 4 Rate of child PTSD symptoms in East Christchurch 2005-2018.

Each blue data point represents a different group of children entering school that year. As they enter school, children have not experienced strategies. The children who were five-year old are included in the "all ages" group for that year. The all ages group data are from schools not implementing strategies at that point in time. The asterisk (*) indicates 2013. Children younger than 3 or not born at first earthquake in 2010 began entering school in 2013. PTS symptom score for 2005 and 2006 from five year olds entering school (Liberty et al., 2010 and Liberty et al, 2016). PTS symptom scores for 2012, 2013, 2014 and 2015 from Study 2 (Liberty, 2017; Liberty et al., 2016). PTS symptom scores for 2016, 2017 and 2018 from the Replication Study 4 (as described in this report)

Why children starting school in 2018 may be impacted by earthquakes and post-disaster events

Children who were aged five years in 2017 and 2018 were born in 2012 and 2013, and in utero in 2012-2013. Earthquakes and post-earthquake stressors continued during this period. According to GeoNet, between April of 2012 (estimated first trimester prenatal period of children entering school in 2018) and June of 2018 (estimated age of turning five years old and

starting school range), there were 14,630 earthquakes in Canterbury, of these 44 were M5 or larger, an additional 310 were in the M4 range. Also, during this period, many families were experiencing stress on almost a daily basis, due to earthquake-related changes to family circumstances (e.g., moving house, changing jobs) and community life (e.g., school closures and mergers). Maternal stress and maternal mental health during pregnancy affect the unborn child's later development and particularly may affect how they react and cope with stress (Van den Bergh, et al., 2017). For example, maternal stress following flooding in Queensland during 2010-2011, an arguably more limited natural disaster than the Canterbury earthquakes, has been shown to cross the placenta and may affect child development and behaviour (Simcock et al., 2019). Paternal stress levels have also been shown to have an epigenetic effect on children (Chan, Nugent & Bale, 2018; Yeshurun & Hannan, 2019). Pre-natal stress may affect children differently and independently of stress experienced postnatally (Lin, Xu, Huang, Jia, Zhang, Yan, & Zhang, 2017).

Thus, the behaviour of children entering school in 2018 shows similar impacts on symptomatic behaviour as those of children who were born in 2008 and started school in 2013 (Figure 4). A combination of pre-natal and ante-natal stress over an extended period is likely to produce the continuing high rates of PTS symptoms shown in our study groups at age five. The rate of PTS symptoms has been consistently high over the years since 2013, measured across different groups of children.

The Public Health Model of Prevention

The public health model of improving wellbeing focuses on change over time in a stepwise approach (Winslow, Sandler, Wolchik & Carr, 2014). First, strategies focusing on improving the general wellbeing of everyone are introduced, then strategies for small groups, and finally, strategies for still-affected individuals. Therefore, the strategies in this project were conceptualised as a tiered process, aligned with a public health model.

In prevention models, a public health approach is to target the entire population that is at risk of cumulative effects. After an earthquake or another natural disaster such as flooding, those most at risk are vulnerable populations, and, more specifically, young children. Young children are a vulnerable population because they are reliant on adults for decisions and management of their health and wellbeing. Due to developmental trajectories, young children have limitations on their ability to access safe locations without adult guidance, to understand the world around them, to understand verbal and other forms of communication, to process

environmental stimuli, to regulate their own bodies, to understand their internal emotions and reactions, to cognitively process information, and so forth. These developmental realities make young children very vulnerable to the effects of earthquakes. For example, they cannot use cognitive strategies to calm themselves down, physically determine where to move to be safer, follow or understand complex verbal directions, communicate or understand their internal states and the world around them.

To be effective, prevention programmes have to target populations with the most risk of adverse outcomes. Therapeutic programmes such as cognitive behaviour therapy and counselling for individuals can be effective, but can only meet the needs of a small proportion of affected children (Fazel, Hoagwood, Stephan & Ford, 2014). However, prevention programmes that can target a larger proportion of people who have a somewhat lesser but still moderate risk level would have the maximum impact (Davis, MacKinnon, Schultz & Sandler, 2003). School are a logical location to meet this goal.

> *Mental health services embedded within school systems can create a continuum of integrative care that improves both mental health and educational attainment for children. To strengthen this continuum, and for optimum child development, a reconfiguration of education and mental health systems to aid implementation of evidence-based practice might be needed. Integrative strategies that combine classroom-level and student-level interventions have much potential. A robust research agenda is needed that focuses on system-level implementation and maintenance of interventions over time. Both ethical and scientific justifications exist for integration of mental health and education: integration democratises access to services and, if coupled with use of evidence-based practices, can promote the healthy development of children.*
>
> *Fazel, Haogwood, Stephan & Ford (2104), p. 377.*

In PTSD, high risk means that, given their current status, in the future, there is an elevated risk that the individual will develop mental health problems, problems in interpersonal relationships, education and employment, and particular negative physical health outcomes. If a person who is already at a high risk experiences another adverse event with traumatic impacts, then that risk increases even more. Prevention for this individual is about restoring health and wellbeing, and helping them competence in skills for the future because it is simply

impossible to prevent them from experiencing another adverse event (Greenberg & Riggs, 2015). At present, high risk for PTSD and other mental and physical health problems is associated with experiencing three or more adverse events before adulthood. This doesn't mean however that every individual who experiences three or more adverse events will inevitably have negative outcomes, but that the probability of negative outcomes increases with each additional event. In young children, those who have experienced three or more adverse events are more likely to already demonstrate behavioural and learning problems.

Moderate risk can be identified in those who have experienced one or two traumatic events. Their risk is moderate because they have not already experienced three or more events. Improving the health and wellbeing of these children, as well as helping them learn positive coping skills, can help prevent their experiences of a subsequent adverse event.

The most likely way to assist a large group of children in a disaster-affected community is through the schools. However, most-school-based interventions were individual psychotherapy or cognitive behaviour therapy delivered by clinically trained professionals using a school setting (Rolfsnes & Idsoe, 2011), and thus duplicated the therapeutic interventions available through the mental health system. Unfortunately, there were insufficient professionals available to deliver individual or small group therapy to all of the children with serious symptoms, as discussed later. A recent review did not identify any evidence for successful trauma-informed school-based interventions (Maynard, Farina, Dell & Kelly, 2018) or school-based strategies following a natural disaster (Liberty, 2017). Thus, the strategies trialled in our series of studies is an original approach to addressing children's PTS symptoms from an understanding of their neurological basis – using a health promotion-health prevention approach.

In a review of school-based prevention, Mark Greenberg (2010) identified the challenges facing incorporating a health- prevention approach in schools. Challenges arose because of the developmental stages and levels of care implemented in the design of universal Tier 1 interventions. He suggested that the design and application of prevention practices would require an intensive degree of collaboration in which learning from each other would be essential. This included the importance of attending to academic performance (not just mental or physical health) and resilience.

An understanding of the stressors facing schools, communities and families is essential to understanding how strategies were developed, trialled and replicated in schools, kindergartens and preschools.

CHAPTER 2. COMMUNITY CONTEXTS 2015-2018

Stressors in Schools

Principals and teachers, as individuals, parents, and family members, as well as trained professionals, are not immune to the effects of stress associated with earthquakes, other community stressors, or adverse events in their families (e.g., Carley, 2017; Mutch, 2015; MacDonald, 2014; Long & Wong, 2012; O'Toole, & Friesen, 2016; You, Zhang & Liu, 2009).

Stress within schools can result in burn-out, anger, frustration and anxiety within the staff, and these problems have been studied for decades (e.g., Kyriacou & Sutcliffe, 1977). In addition, teachers themselves may be at high risk to develop PTS symptoms themselves due to stress associated with teaching pupils with behavioural difficulties (Harmsen, Helms-Lorenz, Maulana. & van Veen, 2018), and one study reported a higher prevalence of PTSD for teachers and others than frontline staff (McBride et al., 2018).

Stress within schools may increase with staff turn-over, changes in staff morale, earthquake-related stressors on principals and school staff (e.g., decisions and work around physical rebuild and repair issues), stressors on individual teachers (e.g., staff divorce, illness, etc.) and so forth. These issues affected all of the communities of the pilot and replication schools during 2015- 2018.

The fact that so many principals and schools, children and parents, chose to participate in the strategy study and replication, and over such a long period is a testament to their commitment and resilience.

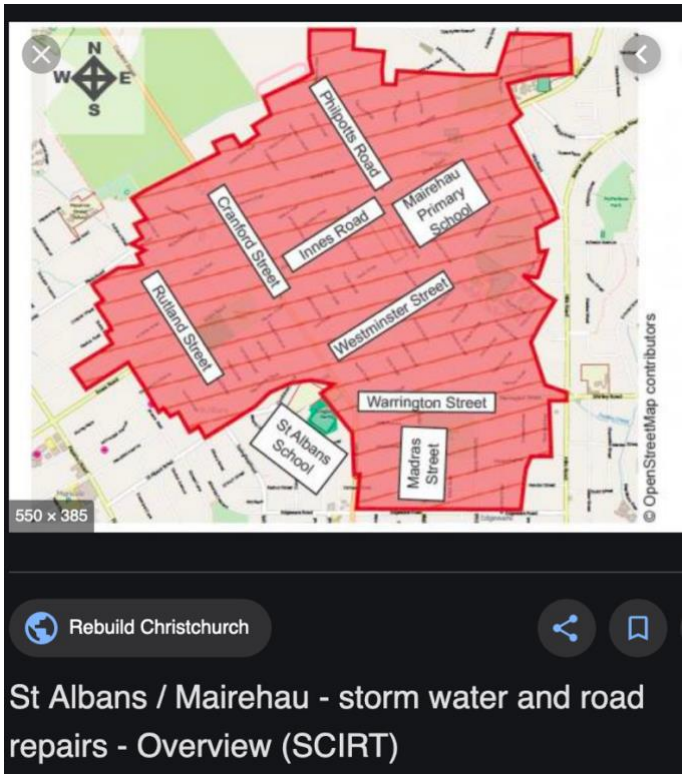

Figure 5 Stress indicators around two local schools: storm water, flooding, and road repairs.

School Closures, Mergers and Rebuilds

Following the February 2011 earthquake, 18 schools were relocated, 55% of secondary school students were "site sharing" with another school, and over 12,000 students were forced to change schools due to earthquake-damage or school mergers (CERA, 2015, p. 1).

One year after the February 2011 earthquake, the NZ government announced the permanent merger of 18 schools and closure of 13 schools (CERA, 2015). This created huge disruption and stress to school families, given the central role school plays in communities and social activities (Cloke & Conradson, 2018; Ferris & Petz, 2012; McColl & Burkle, 2012). Although protest and consultation reduced the mergers to 11 schools merging into five, the overall process was perceived as unfair by 69% of the school principals (Duncan, 2016; Murphy, 2016). The cumulative effect of these stresses, and other potentially traumatic events and experiences, has had a significantly negative effect on the mental health of Christchurch residents.

Figure 6 Headline from Hayward & Fletcher, 2017.

A commissioned review by the Chief New Zealand Ombudsman conducted by Judge Peter Boshier, published in 2017, identified significant shortcomings by the government in regards to these processes in post-earthquake Christchurch (Boshier, 2017). This led to a government apology (Hayward & Fletcher, 2017; Figure 6), but the damage to the mental health of principals, teachers, parents, children and communities by the mismanagement cannot so easily be undone.

Innovative Learning Environments

According to the New Zealand Ministry of Education, Innovative Learning Environments (ILE) are characterised by changes in the delivery of instruction to children, supported by changes to the classroom organisation and size. An important change is the reorganisation of instructional space to provide more flexibility in the delivery of instruction. This has resulted in the reduction of the use of walls and doors as traditional divisions in single-cell classrooms, providing instead larger spaces which can accommodate large groups of children together, as well as providing spaces that can be separated by bookcases, tables, beanbags or screens, for example, to permit different types of activities. It is hypothesised that in ILE, teachers, rather than being solely responsible for a single group of children in a single space, become co-teachers with their colleagues, allowing a sharing of strengths, skills and approaches (Education Central, 2019; Ministry of Education, n.d.*a*). ILE are also thought to more easily enable the incorporation of modern technology, with many tablets and access to e-learning featured in the curriculum delivery (Ministry of Education, n.d.*b*).

Innovative Learning Environments also included improvements to a school's physical environment by the use of modern construction techniques to improve air quality through ventilation and control of temperatures through insulation, air conditioning and heating, and

also to improve, lighting and acoustics. These elements were addressed in rebuilding and repairing schools damaged or closed by the earthquakes.

ILE in Study Schools

The process of implementing ILE in study schools was continuing throughout the strategy period. All study schools were damaged by earthquakes, and these were repaired to safe standards before re-opening. One original strategy school was completely rebuilt to ILE standards by the end of 2017, and one replication school by the end of 2018. Three new merged schools, which participated in the replication study, were rebuilt and completed in 2016 and 2017. The Ministry of Education aims to reform all schools in New Zealand by 2030.

The introduction of ILE within the study schools and communities of Christchurch has not been without stress, concern and conflict (Jones, 2018; Smardon, Charteris & Nelson, 2015). Issues related to children's ability to self-regulate in the larger physical spaces and with more children, teacher preparation and professional development for the new demands, difficulties with technology, the quality of re-purposed single cell classrooms in older school buildings and the availability of appropriate resourcing and staff levels. Principal, teacher, parent and community concerns about child learning and health in ILE also impacted on school functioning and stress during the project.

Teacher Retention

Teacher shortages were a source of stress in school and family communities during the years since the earthquakes. Many individuals and families, and including teachers, moved away from Christchurch after the earthquakes. Other teachers left the profession with some identifying the many changes in schools and pupil behaviour, as the impetus to leave. Teachers also shifted schools due to school mergers and closures, as well as damage to their homes which caused them to move to another part of the city. An overall shortage of relief (substitute) teachers, issues regarding pay and leave, problems with Ministry pay system software and related issues also contributed to the high levels of stress. One principal said that, in their community, many families had left their homes without repairing them, and these homes were now rented to people that were more transient and with more difficult children than the teachers were familiar with, and this had caused teachers a great deal of stress and difficulties in adjustment. The principal was hesitant to ask stressed teachers to change their classroom or

schedule for the strategies, as it would add to their stress, and it was very difficult to find qualified new teachers for the school. A new plan to address shortages was announced in late 2018 by the government (Hipkins, 2018).

Formal Disciplinary Procedures

Use of formal disciplinary procedures is reflected in statistics for stand-downs, suspensions and expulsions can reflect issues in the wider community. Definitions from: "Education Counts (2019)" describe these formal disciplinary procedures:

Stand-down. Stand-down is the formal removal of a student from school for a specified period. Stand-downs of a student can total no more than 5 school days in any term, or 10 days in a school year. Following stand-downs, students return automatically to school.
Suspension. Suspension is the formal removal of a student from school until the board of trustees decides the outcome at a suspension meeting. Following a suspension the board may decide to lift the suspension with or without conditions, to extend the suspension, or in the most serious cases, to either exclude or expel the student.
Exclusion. Exclusion means the formal removal of a student aged under 16 from the school, and the requirement that the student enrol elsewhere."

Nation-wide, children from low decile schools, boys and children identified as priority ethnicity had the highest rates across all forms of disciplinary action. The two most common reasons given for disciplinary procedures were physical assault and continual disobedience—both of which are within the symptoms associated with PTSD. There may be higher stress levels in schools with children with PTSD symptoms, resulting in higher rates of disciplinary procedures. Teachers might have higher stress levels from dealing with students, children might have more frequent triggers in schools with high stress levels, children might have higher levels of fear from seeing school discipline procedures or hearing about children who have been formally disciplined or seeing children with difficult behaviour. All of these scenarios might interact to produce higher rates of formal disciplinary measures in schools.

The age-adjusted rates of stand-downs, suspensions and exclusions per 1,000 pupils aged 5-9 years in Christchurch have increased much more than those in the neighbouring Selwyn District and as compared with national rates (Figure 7, from Education Counts, 2018 a, b, c, d).

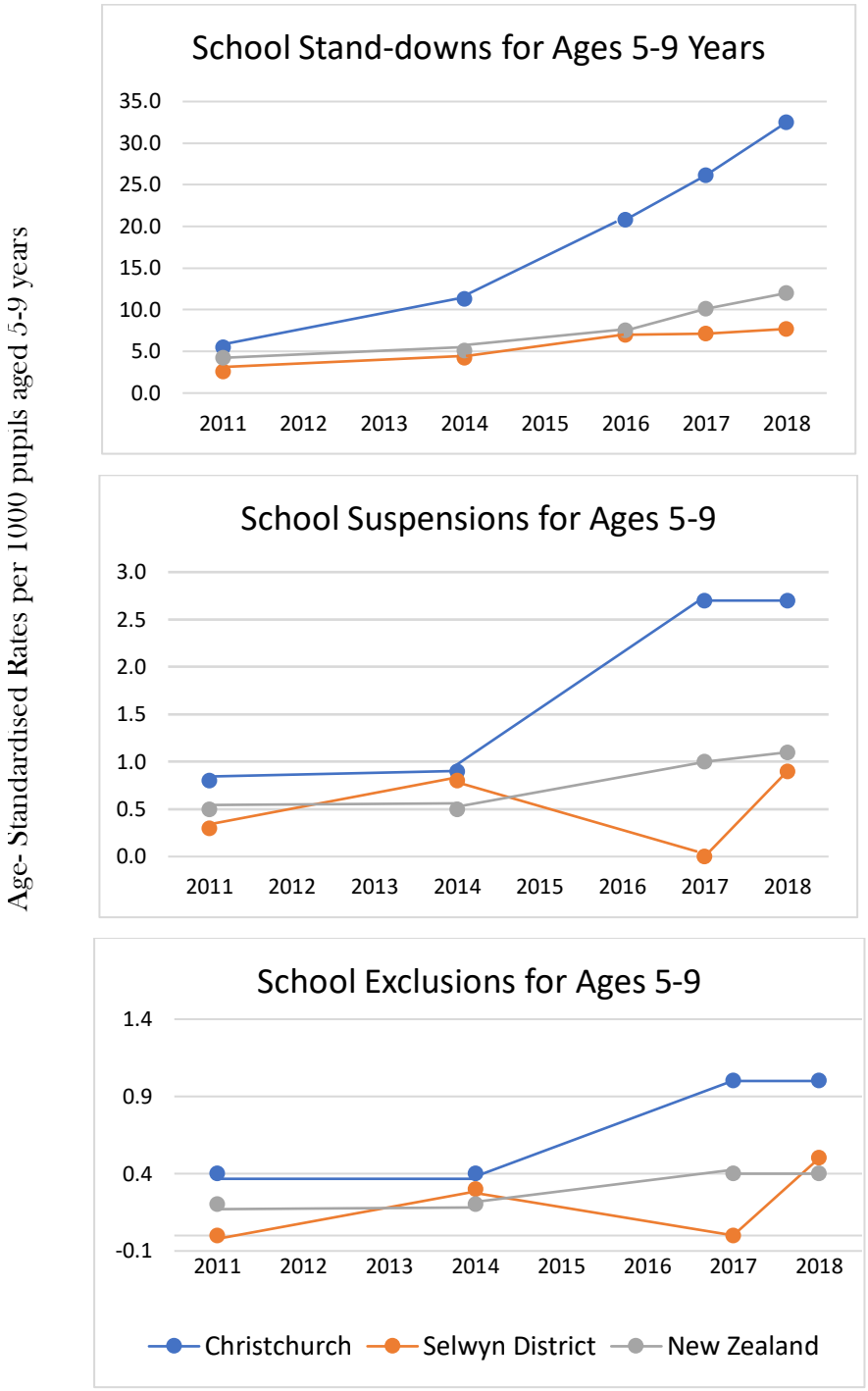

Figure 7. Formal disciplinary procedures for school children aged 5-9 years in Christchurch City, neighbouring Selwyn, and nationally.

(Source: Education Counts 2011, 2014, 2016, 2017, 2018).

National Standards

A uniform assessment system was introduced by the Ministry of Education in 2008, which developed standardised achievement levels for reading, writing and math in the primary school years, and was initially implemented at the beginning of 2010 (Tearney, 2016). This was perceived by some as reducing school autonomy embedded in the Education Act of 1989, by replacing local and community standards with an untested metric (Thrupp & Easter, 2012; Figure 8). National standards were widely regarded as ignoring differences between school communities and children's differences in readiness for beginning school (Lee, n.d.), requiring a large amount of paperwork, and contributing unnecessary additional stress on children, parents, teachers and principals (Thrupp & Easter, 2012).

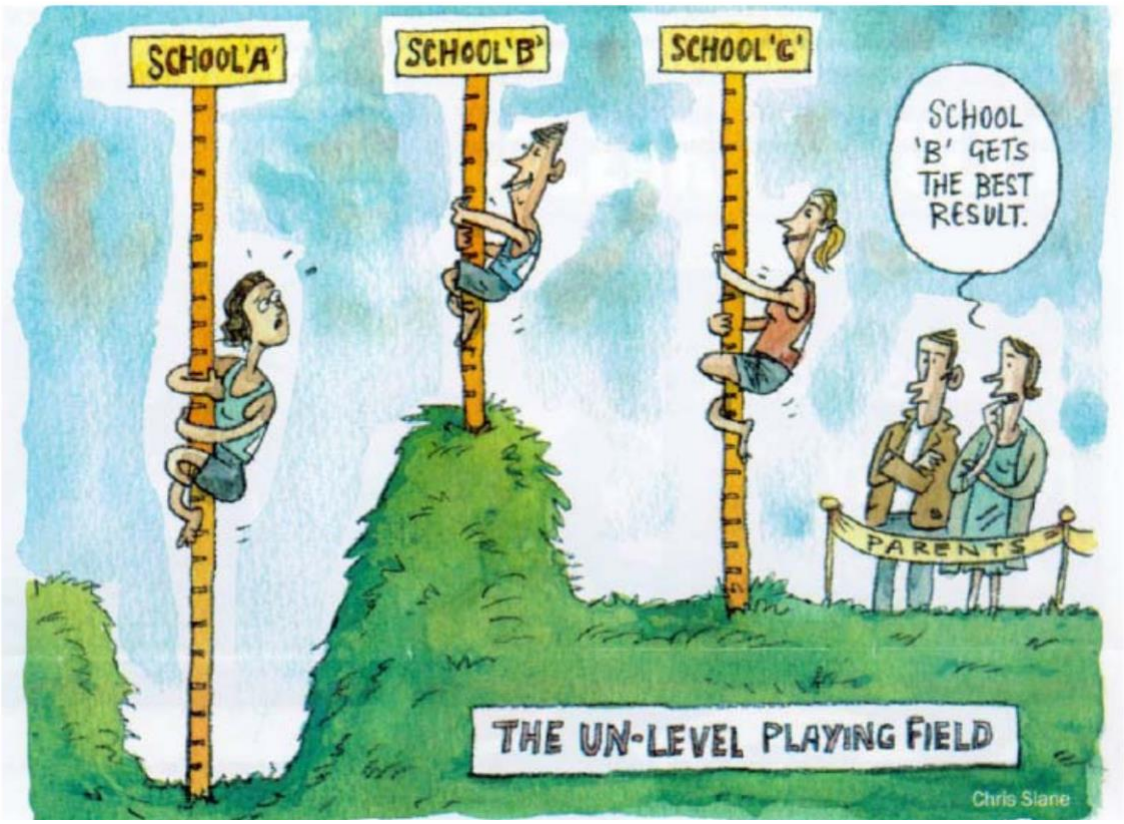

Figure 8 One perception of national standards (Lee, n.d.).

Early in 2018, the new government relaxed requirements for using National Standards and asked that schools determine the assessment standards best suited for their community (Warner, 2018).

Support Services

Schools in disaster-affected communities or schools in communities with high rates of trauma-affected children, generally have a three-tiered model of support for children's wellbeing. These include "Tier 1" supports that are provided across the school community, "Tier 2" supports that are provided to targeted groups, and "Tier 3" supports that are provided to targeted individuals (Rossen & Cowan, 2013). In the present study, schools provided access to Tier 2 and Tier 3 supports provided through a variety of services. Parents may have also have accessed Tier 3 supports for their children.

Special programmes

School Boards of Trustees including the school principal funded special programmes to support children's learning. The principal and teachers determine which children participate in these programmes. During the study period, these include Tier 1 programmes such as Positive Behaviour for Learning (PB4L) and Ka Hikatea Māori Achievement, which involved the entire school, and more targeted programmes (Tier 2 or Tier 3), such as Perceptual Motor Programme (PMP), Reading Recovery, ESOL programmes and Agility with Sound (AWS). Many study schools were involved in these programmes.

Learning and Behaviour Services (RTLB)

The Ministry of Education provides support to schools through many different services, including the services of specialist resource teachers who provide support for children with learning and/or behaviour issues [Resource Teachers of Learning and Behaviour (RTLB)]. Schools make referrals, and the RTLB contact parents and teachers for an agreement to provide support services, beginning with an initial assessment. The assessment results in a discussion led by the RTLB with the child, parent, and teacher regarding recommended support services. The types of supports are individualised to the child.

Other Support Services

The Ministry of Health provides specialist psychiatric and clinical psychological services through the Child and Adolescent Mental Health Services and the Child and Family specialist services and the school-based mental health teams, as well as supporting the community through the All Right? And SKIP programmes. "All Right?" also developed resources for teachers. The Canterbury District Health Board also provided support to schools through the Health Promoting Schools Programme. Additional services were provided through

Community Trusts, including programmes for parents and children provided by the Neighbourhood Trust, Barnardos, the Methodist Mission, and the Graham Dingle Foundation (Kids Can). The Neighbourhood Trust developed a series of videos to support parent services, with help from the Rata Foundation, the City Council, and many other groups.

Your Child & Stress - Let's fix this mess!

Figure 9 Videos for parents from the Neighbourhood Trust.

https://nht.org.nz/parenting/

Supports through Parent and Family

Parents and caregivers can privately access services for their child and family, including private counselling, psychological and/or tutoring support to children and/or the family, and families can provide support for children's learning and behaviour, such as through Numberworks math tutoring and Neighbourhood Trust (e.g., Figure 9). Parents' access and choice of services may be guided by advice from professional support services.

Mana Ake Mental Health Services

In 2018, the government announced $30 million over 3 years for mental health staff to be provided through Christchurch schools to provide Tier 3 services (Ardern, 2018). Mana Ake, coordinated through the Christchurch District Health Board and the Canterbury Community Health Network, provides liaisons within each school to respond to referrals from parents and provides individual support to families and information to schools. A liaison was provided to

almost all study schools and replication schools by the start of Term 4, 2018, but no study children were reported to have accessed this service. It was planned to complete the initial roll-out of Mana Ake by mid 2019 (Canterbury District Health Board, 2018).

Enrichment Activities

Research from both biological psychiatry, psychology and education have pointed to the importance of activities that enrich traditional developmental experiences. From a biological perspective, environmental enrichment involves increasing the complexity and novelty of an organism's environments which can stimulate certain types of neurophysiological activity, including changes to the hippocampus, one of the parts of the brain affected by PTSD (e.g., Kelly & Hannan, 2019).

Engagement in additional activities, such as sport and music-related activities, during or after school can enrich children's learning and behaviour (Peters, Petrunka & Arnold, 2003). Posner and Vandell (1999) reported that children who spent time in after-school activities such as sport or music during grades 3-5 had better adjustment and emotional well-being, taking into account important variables such as adjustment level at the start of the programme, family structure, poverty level, neighbourhood deprivation level and crime rates. Enrichment within schools can also produce beneficial effects (Renzulli & Purcell, 1995).

In New Zealand, School Boards of Trustees and Principals can fund enrichment activities for children to be provided within the school. The principal, teachers along with children and parents determined which children participated in these programmes.

In the present study, these included activities which have evidence for their positive impact, including: school sports (Holt, 2008), Kapa Haka, robotics and coding programmes, ukulele groups and choir, as well as programmes for Gifted and Talented children.

Previous research had indicated the benefits of these activities. For example, McPherson, Mackay, Kunkel, and Duncan (2018) studied 601 children aged 6-11 in New Zealand using pedometers to measure steps. Increased physical activity was significantly associated with better cognition and academic performance. Nopembri, Sugiyama & Rithaudin showed improved problem solving and positive coping skills in children with severe stress after experiencing a volcano eruption in 2010. They engaged in more cooperative games, PE and sports, compared to children who received traditional curricula. Kerehoma (2017) reported that Kapa Haka

helped secondary students in secondary school by supporting their link to culture, identity and connectedness, and improving their confidence. Hollands, Sutton, Wright-St. Claire and Hall (2015) reported on adult's improved mental health after participating in Kapa Haka. Paenga (2008) reported on Kapa Haka as a vehicle for improved health of Māori., and the wider benefits were reported by Pihama, Tipene and Skipper (2014). Toh et al. (2016) reviewed the effects of robotics in the junior school grade levels and showed it improved language development, as well as interest in science and cognitive skills. Francis, Kahn and Davis (2016) identified that spatial reasoning and deep task engagement were associated with coding and robotics. The Ministry of Education (2019) reports that a self-directed digital knowledge approach to teaching digital literacy, including robotics and coding, positively affected children's engagement across cultures, and supported children's science and maths learning. Schellenberg, Corrigall, Dys, and Malti, (2015) found that children with a mean age of 8 years in grades 3 who had low social skills and who learned to play the ukulele in groups in a school-based programme showed improved prosocial skills. The authors' hypothesised that these lessons promoted synchrony across biological, contextual and emotional states. Good and Russo (2016) showed that singing together, as in a choir, improved the social cooperation of children aged about seven years, as compared to competitive games (worsened cooperation) and art projects (did not affect social cooperation).

Parents and community groups can also provide enrichment activities for their children, including lessons on musical instruments, ballet, and sports clubs.

Research also supports these types of activities. For example, a meta-analysis by Sala and Gobet (2017) reported that instrumental music training may improve children's cognitive skills and academics, including memory. Chatzopoulos (2019) reported that seven-year-old girls who participated in ballet had improved proprioception and the ability to synchronise their movements as compared to a control group who participated in physical education. Watson and colleagues (2019) report that children aged 9-11 years who participated in either individual or team sports had better attention and self-regulation as compared to children who did not participate. These activities may make important contributions to children's mental health is a post-disaster community, so it is important to understand their effects in evaluating the strategies introduced in schools.

It is within this context that the project to introduce positive strategies to improve the mental health of children with high levels of post-traumatic stress symptoms was introduced.

Community Stressors

During the implementation of the strategies, which began in Term 2, 2016, the stressors on schools, families and communities continued. This section describes some of the notable stressors, in addition to those related to the immediate aftermath of the earthquakes beginning in 2010 that affected all of the communities involved in the Strategies studies (i.e., Studies 3 and 4).

2016

During 2016, there were several notable additional stressors in the community and schools. Community stressors affect everyone in a community to a greater or lesser degree. It is in this context that the strategies comprising Step One were initially introduced.

Valentines' Day and Kaikoura Earthquakes

Earthquake frequency was at a record level of more than 32,000 across New Zealand in 2016 (GeoNet, 2017). Of these, 1633 were greater than Magnitude 2.9 and struck in Canterbury (GeoNet, 2019).

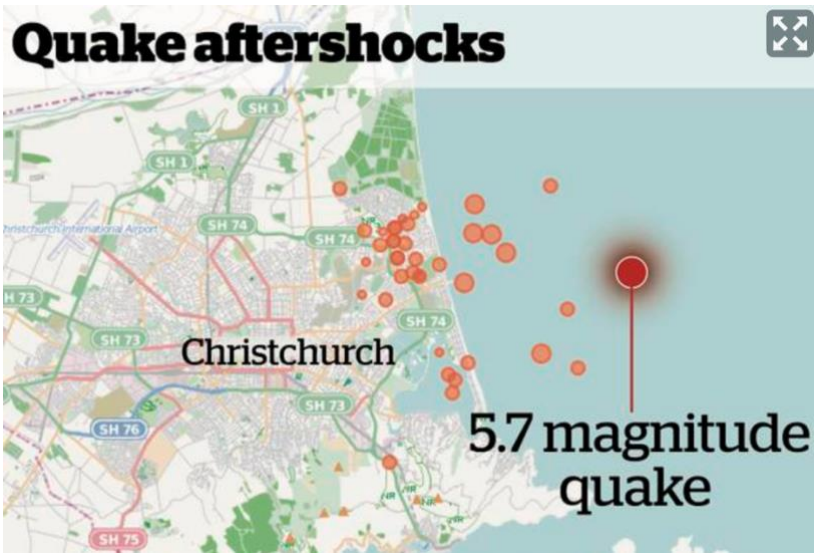

Figure 10 Christchurch earthquakes on Valentine's Day 2016 (New Zealand Herald, 2016).

Valentine's Day Earthquake Christchurch. A M5.7 earthquake struck Christchurch, the largest since May 2012, on Valentine's Day (Figure 10). This was during the second week of the new school year. It caused damaged rock faces and cliffs to collapse, and damaged facades on historic buildings, and caused liquefaction in some neighbourhoods on the east side of the city.

There were 12,000 claims for damage to homes, but no deaths or injuries were reported. Earthquakes continued to be felt in the neighbourhoods of the study schools. There were 300 additional aftershocks by the end of the month, including a M4.7 (Fyers, 2016).

Kaikoura Earthquakes. Most notably, on 14 November 2016, a M7.8 earthquake struck near midnight about 180 km north of Christchurch in the small town of Kaikoura, which resulted in 2 deaths and 57 injuries in a population of about 3500 people. Over the next 12 months, there were more than 20,000 recorded aftershocks, which occurred over a wide area of the South Island and lower North Island. This earthquake sequence caused severe disruption to the infrastructure and also led to the re-evaluation of many buildings in terms of earthquake resilience, particularly in the capital city, Wellington. The extent of the damage, the deaths, and the extraordinary changes to the seabed in the region emerged over the next several months.

High Rates of Stress and Suicide

In April and September of 2016, The Canterbury Wellbeing Index reported that about 75% of adults in Christchurch City reported they experienced stress sometimes, most of the time or always in their daily lives (Canterbury District Health Board, 2016a, b). Mental health in the neighbourhoods of the participants continued to show the adverse effects of the earthquakes and post-quake stressors. Secondary students on the East side of Christchurch were particularly noted as suffering from mental health problems including anxiety, low self-esteem and self-harm (Social Policy Evaluation and Research Unit, 2016). NZ has the highest youth suicide in the world (Glenn et al., 2019; McConnell, 2016) and suicide is associated with PTSD (Panagioti, Gooding, Triantafyllou, & Tarrier, 2015) and earthquakes (Morishima et al., 2019). In 2016 (and again in 2019), Canterbury recorded the highest suicide rate in New Zealand (Wright, 2016; Henry, 2019), with many linked directly to the earthquakes (Carville, 2016). Earthquake have been linked to higher rates of suicide ideation and related problems six years after an earthquake (Tanaka, Tsutsumi, Kawakami, Kameoka, Kato, & You, 2016).

2017

During 2017, there were additional stressors. In Christchurch, the population was greater than the pre-earthquake population for the first time, reaching 381,500. Stressors in 2017 affecting the community included earthquakes, a bush fire, and flooding, as well as continuation of pressure on the mental health services.

It was in the context of these events that the Step Two strategies were introduced in the original schools, and in additional schools, pre-schools and kindergartens in the Replication Project.

Earthquakes

According to the New Zealand Earthquake Commission, GeoNet reported 320 earthquakes greater than M3.0 in Canterbury during 2017 (GeoNet: Geological hazard information for New Zealand, 2018). Of these, four earthquakes were greater than M5.0. Of these large earthquakes, two occurred during the first three weeks of the school year, one at the end of the second month of the school year, and one in the second week of Term 4. Many families still do not have an insurance settlement on their home, while the number of homes found to have poor quality repairs increased (Hayward, 2018).

Port Hills Fire

Also, during the first month of the school year, there was a fire in the Port Hills (Figure 11), a large area in the city limits that is mostly reserve land, with few houses or buildings. However, the Port Hills overlooks the Central Business District and are easily visible from all participating study schools. The fire raged out of control for three days (February 13-15)—coinciding with the first two weeks of the school year, and burned more than 1660 hectares.

Figure 11 Port Hills Bush Fire February, 2015. Photo: Ross Younger.

https://www.flickr.com/photos/crazyscot/32097904133/; Caption. Christchurch, New Zealand, 15 February 2017. Multiple fires are burning out-of-control in the Port Hills above Christchurch. This photo taken around 4:30pm. CC By-SA 2.0 (https://en.wikipedia.org/wiki/2017_Port_Hills_fires#/media/File:2017_Port_Hills_fires.jpg)

Flooding

During the 2017 school year, all of the original study schools and their neighbourhoods experienced flooding from Cyclone Cook during Term 2 (Ineson, 2017a) and from record rainfall in 48 hours in Term 3 (Ineson, 2017b). Replication sites and neighbourhoods may also have been affected.

Increased Demand for Mental Health Services

The need for mental health services in Christchurch continued to increase, with one in six receiving support for mental health since the earthquakes (Meier, 2017a; Figure 12). Early in 2018, the government reported there had been an 98% increase in demand for child mental health services between 2011 and 2017 (Ardern, 2018) and an increase in suicide rates (Bewley, 2018), suicide attempts, domestic violence and addiction (Hayward, 2018).

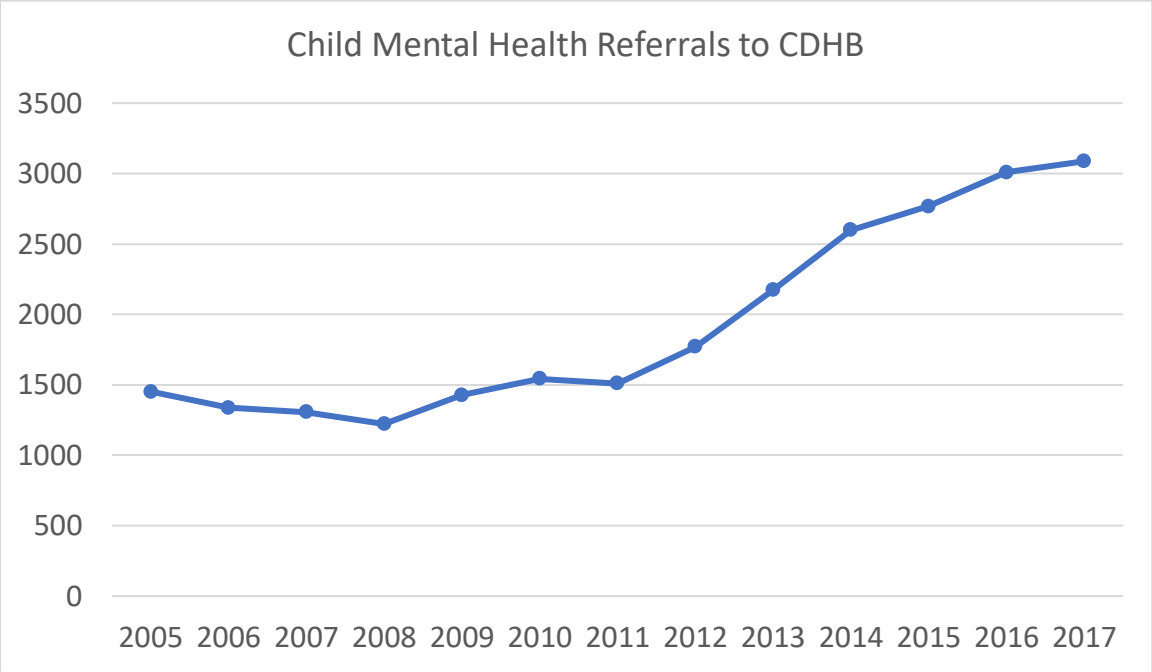

Figure 12 Increases in new cases of children referred to Canterbury DHB for mental health treatment 2005 to 2017 (Keogh, 2018).

Sadly, wait times for services increased, in 2017 with almost 60% of children under 12 years of age waiting longer than 3 weeks for a first appointment, compared to about 41% in 2016 (Meier, 2017b). In 2016, the district health board also pointed out that 92% of children then waited more than two months for their second appointment (Meier, 2017, b), but similar data for 2017 were not available. Questions about the quality, access, and physical condition of mental health services were raised (Gates, 2017; Meier, 2017c, d). The Canterbury District Health Board was reported to have a $45million budget "blow out" due to providing mental health services in excess of those anticipated (Broughton, 2017a).

2018

During 2018, neighbourhoods of the original and replication study schools, kindergartens and preschools, and families experienced earthquakes, flooding, the first-ever chlorination of the water supply and a shortage of mental health services. Visual reminders of the earthquakes were unavoidable (Figure 13), as road works to repair water, sewage, power and other infrastructure continued.

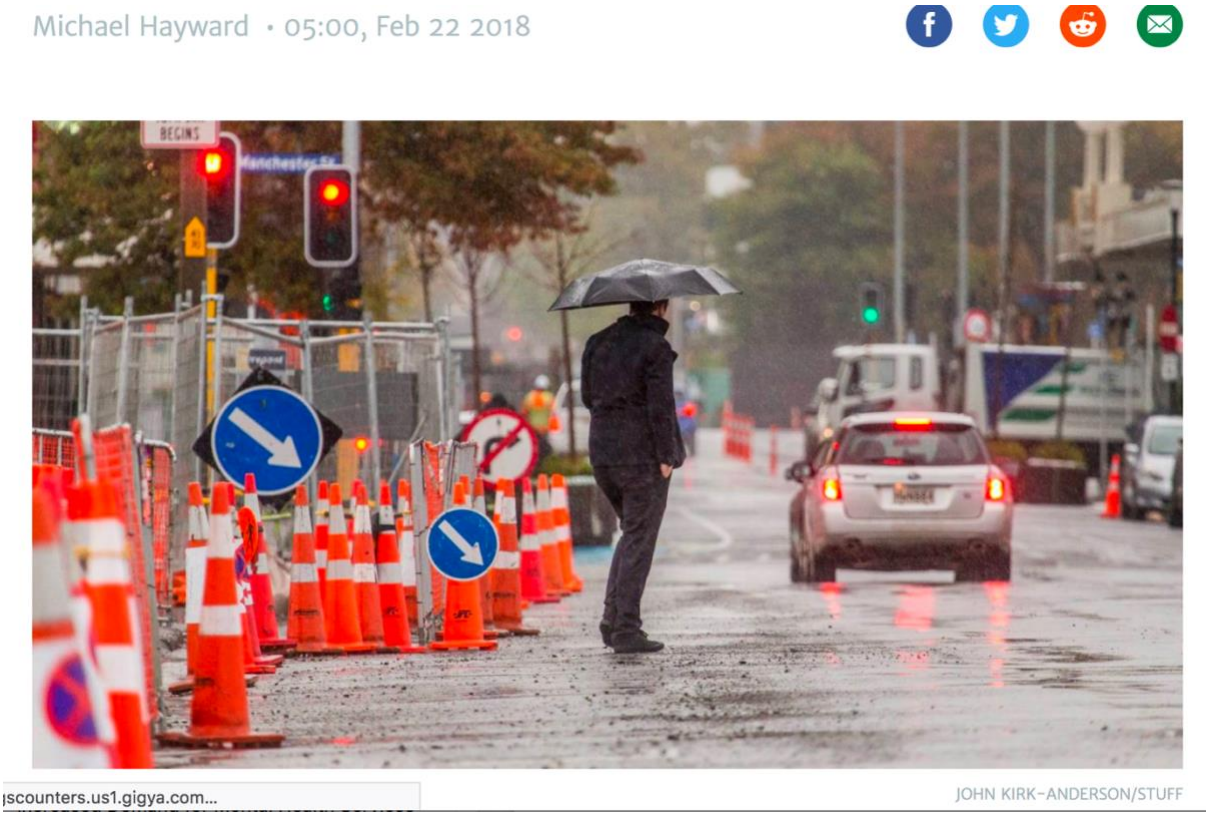

Figure 13 Visual reminders of earthquakes continue in city envrionments in 2018

"The Christchurch City Council estimates there is more than 20 years of work to get the roads to a condition in line with other cities in New Zealand" (Hayward, 2018).

Earthquakes and Floods

According to the New Zealand Earthquake Commission, GeoNet reported 115 earthquakes greater than M3.0 in Canterbury during 2018 (GeoNet: Geological hazard information for New Zealand, 2019). Of these, eleven earthquakes were greater than M4.0 (the largest was M4.7, on 7 March 2018). Many families still do not have an insurance settlement on their home, while the number of homes found to have poor quality repairs increased (Hayward, 2018).

During the 2018 school year, neighbourhoods experienced flooding from Cyclone Gita during Term 1, and council decision-making regarding frequently flooded homes in June.

Water Quality and Chlorination

Due to issues with water quality and the water delivery infrastructure, the Christchurch City Council decided to temporarily chlorinate city water supplies, beginning 26 March 2018 (Church, 2018, March). This was a decision that was contested and protested by citizens and groups, as Christchurch had never before had its water treated, and there was community pride for the water quality. Chlorination was associated with anecdotal reports of increased health problems, such as eczema and headaches (Church, 2018, April). Citizens complained that tap water tasted like swimming pools. It eventuated that the initial chlorination levels were too high, and these were subsequently reduced (Newshub, 2018, May). A report later cited the city council for poor communication and implementation of chlorination (Harris, 2018). Water chlorination and public conflict about it also affected schools and family decisions that affected the implementation of the "Drink to Think" intervention strategy. Chlorination continued throughout the final project year.

Pressure on Mental Health Services.

The need for mental health services in Christchurch continued to increase. Early in 2018, the government reported there has been a 98% increase in demand for child mental health services since 2011 (Ardern, 2018) and an increase in suicide rates (Bewley, 2018), suicide attempts, domestic violence and addiction (Hayward, 2018). These events affected all of the study schools. For example, professional development for the sleep education programme was postponed in one school following a suicide in the school community.

Sadly, wait times for services increased, and questions about the quality, access, and physical condition of mental health services were raised (New Zealand Doctor, 2018). The Canterbury District Health Board was reported to have a $109 million budget "blow out" (Brown, 2019).

Summary and Implications

The enduring effects of natural disasters cannot be underestimated and contributes to mental health and wellbeing outcomes for decades after the event (Shaw, Espinel & Schultz, 2012). The events described in this section only touch the surface of the actual day-to-day effects of not only dealing with a disaster-struck community but interacting daily with all of the individuals who are themselves struggling with stress. The response to the disaster in Christchurch must be

recognised as a long-term complex path to community recovery (Blackman, Nakanishi, & Benson, 2017).

The stressors affecting individuals, families, schools and communities must not be minimised, and the courage and resilience in persisting to try to make a difference under these circumstances must be acknowledged and congratulated.

CHAPTER 3. METHODS

Overview of Four Studies

Study 1: Pre-Earthquake Descriptive Study (N=297)

The original purpose of this study was to document the mental health and learning of children as they entered school. Data was collected from teachers, parents and, in some cases, G.P.s This study involved children born in 2001-2002 who had not experienced the earthquakes before they entered school. This study involved 8 randomly selected primary schools, of which 6 were by random chance in East Christchurch. Of the 8 schools, 4 were low decile, two were mid-decile (4-6) and two were high decile. The inclusion criteria were that they enrolled in the participating schools at the school date closest to their fifth birthday and did not have an identified disability.

In the aftermath of the earthquakes and the disruption to schools, the potential use of Study 1 as a pre-earthquake baseline was considered by Maureen Allan and Kathleen Liberty. The location of the schools in Study 1 was deemed to be suitable for comparison purposes, because six were in East Christchurch, the part of the city suffering the most damage Of the six Study 1 schools in East Christchurch, all were severely damaged and five were eventually merged into new schools and one is in the process of being rebuilt. (Of these six schools, all but one participated in the replication study).

The measures used in Study 1 were also suitable to provide a pre-earthquake baseline of behaviour problems, post-traumatic stress symptoms, and self-regulation in children entering primary schools.

Study 2: Post-Earthquake Descriptive Study (N=306)

The purpose of this study was to document the mental health and learning of children as they entered school after exposure to earthquakes before school entry, using some of the same measures as used in Study 1 in order to make equivalent comparisons.

None of the Study 1 schools were involved in Study 2, for the reasons given previously.

Participants were included if they lived in Christchurch on 4 September 2010 (or were not yet born but mother was living in Christchurch) and continued living in Christchurch up until the start of school.

The post-earthquake descriptive study involved five primary schools who responded to an invitation to participate distributed in October, 2012, unfortunately, this invitation was emailed in the same week that the Ministry of Education announced changes to Christchurch Schools (see Chapter 2). At Time 1, the five schools included one low decile school, two mid-decile schools, and two high-decile schools. These schools agreed to recruit new entrant children, and to check that the children and their families had lived in the east part of the city since the first earthquake on 4 September 2010 (this information was later checked with the parents during the study). Recruitment of children began in Term 1, 2013. This included some children who had started school in later 2012 and were considered as 'new entrants' by the school. Recruitment of new entrants continued through Term 4, 2015.

It was the original purpose of the study to follow children for their first few years of school, to determine the longitudinal effects and changes. Children were assessed by their teachers at the start and end of each school year, and additional information was collected from parents, during the three-year study period (2013-2015). Analysis at the start of 2015, however, identified that about half of the children showed worsening behaviour and post-traumatic stress symptoms, and this led to the introduction of strategies intended to address children's stress symptoms and the start of Study 3.

Study 3: Effects of Strategies (N= 360)

The purpose of this study was to evaluate the effects of innovative strategies. Schools that participated in Study 2 were invited to participate in Study 3, beginning in 2016. Study children were those from Study 2 who continued attending the participating schools. An additional school joined the study in 2016. The study involved six schools at Time 1 (two low decile schools, two mid-decile schools and two high-decile schools) which enrolled a total of 2005 children. Study 3 continued until the end of 2018, with data collection over three years of strategy implementation. Effects of the first year of strategies were reported to the wider school community in May 2017, and this led to Study 4.

Study 4: Strategy Replication (N=1530)

The purpose of this study was to determine if effects of the first year of strategies (Study 3) could be replicated in other schools. The Te Paeroa Cluster invited schools to contact them if they were interested in participating, and, when kindergartens and preschools learned of this, some asked if they could also be involved. Maureen Allan and Liz McNaughton met individually with interested schools, preschools and kindergartens to explain study participation. Schools, preschools and kindergartens were asked to randomly select children to participate after deciding on their baseline rate (e.g., if schools wanted a 20% baseline, every fifth child on the school roll was nominated). Teachers completed reports on the children (time 1) and an overall report for each organisation was compiled and reported confidentially to the leadership team. Each organisation then selected strategies to implement (or decided not to implement strategies). Te Paeroa provided support for implementation, including professional development. The organisations agreeing to participate included 12 schools (6 high-decile, 4 mid-decile, 2 low-decile), 8 kindergartens and 12 preschools. The total roll was 5066.

Design of Strategies Studies

There were four studies that contributed to this report, as above, and the methods used in the first two studies have been previously reported in detail (Liberty, et al., 2010; Liberty et al., 2016: Liberty, 2017a). The following section described the methods used Studies 3 and 4.

The initial study of the strategies (i.e., Study 3) involved a longitudinal design over four years (Bor, 2016), and involved the five schools that participated in the original descriptive study of the earthquake-exposed children (Study 2; Liberty et al., 2016). The data collected at the end of 2015 for Study 2 served as the pre-intervention baseline for the initial evaluation of the strategies. Data from the first year of strategy implementation (2016), the second year of strategy implementation (2017) and the third year (2018), collected by teacher-report at the end of the year, have been used to analyse the full set of the strategies.

The replication study, Study 4, was established in the days following the initial presentation of the first year of results of the Strategies Pilot Study at a meeting of the Canterbury Principals

Association on 11 May 2017. The Replication Project was supported by the Te Paeroa Cluster of the RTLB Service, Maureen Allan, Manager, and with the appointment of Liz McNaughton to coordinate the project. The overall aim was to determine if results of the original strategy schools' first step strategy implementation could be replicated in other schools, and preschools and kindergartens also decided to participate. In addition, replication sites were offered RIRO training. They began implementing Step One and Step Two strategies during 2017-2018.

Measures

Data in this report was collected using the Behaviour Problem Index (Peterson & Zill, 1986) the Positive Behaviour Scale (Epps, Park, Huston & Ripke, 2003, 2005; Panel Study of Income Dynamics, 2010; 2017), the Child Behaviour Checklist (CBCL) Competence Scale (Achenbach & Rescorla, 2001) and teacher reports of children's achievement in reading, writing and maths, using the national standards (2015-2017), and school-based measures, 2018). All of the instruments were standardised, freely available scales that had been used in published longitudinal studies. The Behavior Problems Index (BPI) and the Positive Behaviour Scale have been used in longitudinal studies in the United States since the 1990s (e.g., Cooksey, 2018; National Longitudinal Surveys, https://www.nlsinfo.org/; Panel Study of Income Dynamics, 2010, 2017).

Post-traumatic Stress Symptoms

Examination by a qualified psychologist or psychiatrist following a standard protocol, such as the Diagnostic and Statistical Manual of the American Psychiatric Association (Fifth Edition, 2013) is required for a diagnosis of Post-traumatic Stress Disorder. In prevention research, and in post-disaster communities, psychiatric resources (e.g., the use of psychiatrists or clinical psychologists to administer diagnostic protocols) are too limited for population-wide clinical measures. Instead, a screening procedure is used to identify the level of symptoms in the population for prevention science research (National Research Council and Institute of Medicine, 2009). Screening generally uses a brief standard assessment, which is scored as positive for the condition or negative for the condition.

In the present study, a subset of items from the Behaviour Problems Index, as reported by teachers, was used to assess post-traumatic stress symptoms. Teachers have been reporters of child PTS symptoms in other earthquake studies using similar screening checklists [e.g., Eksi &

Braun, 2009; Usami, et al., 2014; Widyatmoko et al., 2011]. In the present study, teachers were blinded to which of the BPI items were related to PTS.

Ten symptoms (Table 2, p. 8) were identified that matched to items on the Child Behaviour Checklist PTSD subscale (Dehon & Scheering, 2006). Teachers were blind to the symptom list when they rated child behaviours. Items were dichotomised as "never true" [score of 0 per item] v. "sometimes true, often true"[score of 1 per item]. Scores were summed, giving a possible range of 0-10. The Cronbach's alpha for the ten-item scale at baseline for the strategies group was .856, and .871 for the Replication group, which indicates a high degree of internal consistency.

PTS Categories and Clinical-level

A mean of 6.1 PTS symptoms in young children diagnosed with PTSD has been reported (Scheeringa, Zeanah, Myers & Putnam, 2005) and a cut-off of 60% of symptoms to identify clinical levels has been reported by Dehon and Scheeringa (2006). Therefore, in the present studies, a clinical-level of PTS symptoms was defined as a score of 6 of the 10 symptoms (Liberty et al., 2016). PTS symptoms were categorised as zero symptoms, 1-5 symptoms, or clinical symptoms (6+) at baseline and again at the end of the study. For the final determination of change, children were categorised using their final data point if they moved before the end of the study.

PTS Change

Change from the clinical category at baseline to either of the lower categories was considered improvement. Change from either of the lower categories to a score of 6 or more was considered a new or delayed clinical case.

Limitation and Implications

The information on PTS symptoms by teacher report does not include information on children's somatic symptoms, such as problems associated with sleep, headaches, stomach aches and so forth. This is important, because sleep problems were the most common PTSD symptom in the original strategies study population, with 74% of children experiencing one or more sleep problems as reported by their parents. Nightmares about the event, or, in young children, frightening dreams with content that the child can't describe, are also a PTSD symptom, and 44% of the children in the original strategy school's population had nightmares.

Thus, the symptoms reported by teachers will likely underestimate the number of symptoms experienced by children, and also the prevalence of PTSD symptoms in the population.

DSM-5 Child PTSD Diagnostic Criteria

As reported above, for large sample research, symptom checklists completed by parents and/or teachers are used to estimate prevalence in the present study. However, a diagnosis of Post-traumatic Stress Disorder is not based on the number or intensity of symptoms, but on the presence of symptoms within specific symptom categories.

The Diagnostic and Statistical Manual of the American Psychiatric Association (5th Edition, 2013) provides a standard protocol for the diagnosis of child PTSD. There are five diagnostic criteria for young children. Briefly, these criteria are: [A] experiencing a traumatic event, such as an earthquake; and showing symptoms that impact on their daily functioning in each of the following categories; [B] intrusion; [C] avoidance/numbing; [D] negative alterations in cognition and mood and [E] arousal. In children younger than 7 years old, the C and D categories are combined, due to the young child's limited ability to have observable signs of avoidance (e.g., being able to avoid the sight of a destroyed building by taking a different route to school) and/or for adults to discern symptoms of a child's mental avoidance (e.g., consciously changing thoughts of the event to thoughts of positive or relaxing events).

The relationships between the PTS symptom scale and DSM-5 criteria were established for the original post-earthquake study group, who were all five years of age at the start of the study. These same descriptions have been used with the children in the replication groups, although DSM-5 symptoms criteria change for older children. A more accurate rate would be obtained if criteria C were separately assessed from Criteria D for the older children. This distinction is possible within the study data, but time constraints have meant that this could not be completed at the time of this report.

In addition to the symptom criteria, the additional requirements are [F] symptom duration of at least a month, [G] impairment of functioning or distress in daily life to a clinically significant level and [H], symptoms not due to any physiological effect of substance use or a medical condition.

An equivalent score for the DSM-5 child PTSD criteria B, C, D and E was established, using items from the BPI (Liberty et al, 2016b). Scores that included one symptom each of Criteria B and C/D, and two of Criterion E were defined as indicative of meeting these PTSD criteria.

The Cronbach's alpha for this scale was .688 for the original strategies group and .744 for the Replication group at baseline, indicating good scale reliability.

Criterion A, experiencing, was considered met due to earthquakes and subsequent post-earthquake events (Chapter 2). As the BPI asks teachers to report over the past three weeks, symptom duration was not quite to the requirement of four weeks, but the requirement for clinically significant distress/ impairment was checked using the competence score and achievement results, which are over the past two-four school terms. It was not possible to check Criterion H, but, in the study children, substance abuse or medical condition producing similar symptoms would be unusual in such a very young age group, and would be expected to be randomly distributed in the replication groups.

There was a very high correlation between the PTS score and the DSM-5 total criteria (e.g., $r=.938$, $p<.001$ for the baseline in the original strategies group), so this analysis provides a picture of the children that is strongly related to the PTS score as well as to the diagnostic criteria.

Self-Regulation

Self-regulation was estimated using a sub-scale of five items from the Positive Behaviour Scale, which was similar to a self-control scale reported by Stoiber and Gettinger (2011). The five items included three relating to behavioural inhibition (i.e., "waits turn", "is organised, does neat, tidy work for their age", and "thinks before acts"), one for mood repair (i.e., "can get over being upset quickly, relative to the situation") and one for positive coping (i.e., "copes with minor stress or hassles"). There was a possible score of 0-5 on each item. A mean item score was calculated by dividing the total score by the number of items rated by teachers. This scale worked well in the studies, with Cronbach's alpha at baseline for the strategies group of .799 and .823 for the Replication group.

"High self-regulation" was identified for children whose mean item score was 4.8 and above (the highest quartile in the pre-EQ children), "average self-regulation" was identified for mean item scores between 3.0-4.749 and "low self-regulation" was identified for children whose mean item score was below 3.0 (the cut-off for the lowest quartile in the pre-EQ group). Children who were already able to successfully regulate their own behaviour at baseline were not as likely to be affected by the strategies as were the children with PTS who had not developed self-regulation.

Academic Achievement and Attitude to Learning

Children's progress against learning standards was assessed at the completion of each 40 weeks (one school year) of school, assessed by their teacher on the anniversary date of their school entry. From 2015-2017, mandated government-established national standards were used, and from 2018, school-approved standards were used.

Although teachers use formative assessment throughout the school year, an annual summative assessment is recorded in terms of the child's achievement against year-level standards for Reading, Writing and Maths, typically this is reported annually during the term that corresponded with the term the child first started school (e.g., if the child had their fifth birthday and entered school in May, their learning was formally reported in Term 2 of each subsequent school year). Thus, these assessments occurred throughout the school year, not at the end of the year. Children's achievement on year-level achievement is assessed as 'well below standard', 'below standard', 'at standard' and 'above standard'. In the present evaluation, the scores were dichotomised as "met standard or above" or "below standard".

Attitude to Learning

Items on the PBS were used to report changes in positive characteristics related to learning: enjoys school and learning, can learn in groups, shows curiosity, follows teacher instructions, persists when facing difficulties and asks questions when unsure. There was a possible score of 0-5 on each item. The mean item score for the six items was used to estimate attitude to learning (Cronbach's alpha for the original strategies group at baseline=.791, Replication group=.825).

Competence and Expectations

Children were also rated on six items adapted from the *Child Behavior Checklist Competence Scales* (Achenbach & Rescorla, 2001), which include children's competence at academic skills (i.e., reading, writing, spelling and math), communication, attendance and school behaviour. Teacher expectations for each item were reported in the first few weeks of the school year in the initial strategy schools, and at baseline in the replication study (Cronbach's alpha for the original strategies group at baseline=.791, Replication group=.825). Teachers reported their expectations for an individual child in comparison with their peers.

Preschool Measures

The Circle of Wellbeing (Education Review Office, 2015) is a positive, strength-oriented approach used in New Zealand preschools. According to the Education Gazette (Wastney, 2016), "*The key competencies of The New Zealand Curriculum and the principles and strands of Te Whāriki [The Early Childhood Curriculum] are aligned in the Circle of Wellbeing and Achievement".*

The preschool teachers declined to use the BPI or another scale that would identify children with stress symptoms, as this model did not fit with their mission. Therefore, a checklist of the Circle of Wellbeing items was used by preschool teachers instead of the BPI and the PBS. Teachers indicated where each child was for each of 52 characteristics on a scale of 1-5, similar to the Positive Behaviour Scale used with schools and kindergartens (Cronbach's alpha at baseline for the total score=.945).

The 52 items are divided into the following subsections:

- Culture and Identity (5 items);
- Connectedness (5 items);
- Learning (5 items);
- Independence (5 items);
- Strengths and Interests (5 items);
- Preparedness for Change and Transition (4 items);
- Engagement and Participation in a Range of Settings (5 items);
- Resilience (4 items);
- Health (5 items);
- Self-Regulation and Management (4 items);
- Communication and Language (5 items).

The total for each subsection was divided by the number of items to provide a mean item score for each subsection (range 1-5).

Clinical group.

The Resilience sub-scale relates to the absence of PTS symptoms, and includes the following four items: copes with minor stress, can express their feelings when upset, copes when things aren't going his/her way and is self-confident. For comparison with PTS in schools and kindergartens, a clinical group was defined as children whose mean score on the resilience

scale (range 4-20) was below 11 and a mean item rating of less than 3, so that their average rating on resilience items was 'not like this child' [rating of 2] or 'not at all like' this child' [rating of 1].

Self-regulation.

The Circle of Wellbeing items for self-regulation were similar to those for the PBS for kindergarten and school children and included: thinks before acts, can get over being upset quickly, usually does what you tell him/her to do, able to regulate their emotions. Low self-regulation was defined as a mean item score was less than 3. As the self-regulation scale was comparable to the kindergarten self-regulation measure, this was used to estimate overall effects for the kindergartens and preschools.

Attitude to learning.

The Circle of Wellbeing includes five items in the Learning subscale, include: is curious and exploring, likes new experiences; waits turn in games and other activities, shares equipment, shows an interest in learning, perseveres with difficult tasks. For comparison purposes, the mean item score on this sub-scale was used for the attitude to learning construct.

Data Analysis Plan

The analyses of the effects of strategy implementation was conducted across schools and used both cross-sectional analysis (all children assessed at a time point) and longitudinal analysis (only children who were assessed at every time point). The analysis plan was to use the teacher-report data to determine the impact of strategy implementation, considering changes in the prevalence of PTS symptoms, the proportion of children in PTS symptom categories (e.g., clinical-level symptoms), DSM-5 criteria and related variables. SPSS v. 25 (IBM Corporation) was used for analysis.

CHAPTER 4. PARTICIPANTS

Overall, a total of 44 educational organisations participated in the four studies. Studying the effects of the strategies (studies 3 and 4) involved 36 educational institutions that enrolled 7,073 children and about 26% of the children (N=1530) were assessed. This is one of the largest studies of child mental health, behaviour and learning to be undertaken in New Zealand independent of the Ministry of Education and the Ministry of Health (and any involvement of central government).

Approved informed consent procedures were used to recruit schools and participants.

School-Age Children

Schools

There were 26 schools participating in the studies, including five schools that participated in both Study 2 and Study 3. These schools also included some schools that participated in Study 1, were merged following the earthquakes, and participated in Study 4. Schools in Study 1, 2 and 3 included contributing and full primary schools. Study 4 included contributing, full and composite schools (preschools and kindergartens are described in the following section).

The overall roll of schools that participated in the studies at each time point is shown in Table 3, and totals 12,381. However, the school roll changes each year, and children might attend the same school throughout their primary education or they might change schools. This indicator is only used to provide a descriptor of the schools in the studies.

Table 3 Characteristics of schools participating in four studies.

	Study 1	Study 2	Study 3			Study 4		
Characteristic	Pre-Earthquake Study	Earthquake-Exposed Children	Strategy Schools	Contrast School 1	Contrast School 2	All Replication Schools	Replication Strategy Schools	Replication Contrast Schools
Year Joined Study (T1)	2005-2006	2013-2015	2015	2015	2015	2017-2018		
Number of Schools	8	5	4	1	1	12	8	4
Low Decile Schools	4	1	1	-	1	2	1	1
Mid-Decile Schools	2	2	2			4	4	-
High-Decile Schools	2	2	2			6	3	3
Total School Roll	3392	1916	1452	464	91	5066		
School Year Levels	NE-8	NE-3	NE-8	NE-6	NE-8	NE-10	NE-8	NE-10
N School Age StudyChildren	297	306	224**	47**	89	1170		
Study Children % Total Roll	93.7*	64.3*	15.4	10.2	97.8	23.2		

* This is the recruitment rate of eligible new entrants entering study schools during the recruitment period. It is not the percent of the total roll.
** These are the children from Study 2 attending schools that continued to participate in Study 3.

School Deciles

Recruitment rates for New Zealand uses a systematic analysis of census data, including employment, income, and housing-related indicators, to construct a Socioeconomicn(SES) Deprivation Index of small geographical units, which is then categorised into ten decile-bands, with about 10% of the national population in each band. Schools with a preponderance of children from addresses associated with high socioeconomic deprivation are designated as schools serving low SES neighbourhoods, and these schools receive a funding supplement. School decile assignments are reviewed periodically. The deciles of schools participating in each study are show in Table 3. Deciles are not assigned to preschools and kindergartens.

As children from high deprivation neighbourhoods are typically identified as having a high risk for negative outcomes, the school decile provides a rough demographic regarding the SES of pupils attending the school. Children from high deprivation neighbourhoods are more likely to experience ACES and thus it would be predicted that schools which contain a high proportion of children from high deprivation neighbourhoods would have higher rates of PTS symptoms.

There were significantly fewer children from low decile schools in the original study group as compared to the pre-EQ group (Study 3 v. Study 1), and significantly fewer in the replication group as compared to the original strategy group (Study 3 v. Study 4; Table 4). Within the replication group (Study 4), there were only 11.8% of children from low decile schools.

However, the replication study group had more mid-decile children as compared to the original strategy schools (Study 4 v. Study 3) (Table 4). There were no mid-decile schools in the replication contrast group.

There were no significant differences in the proportion of participants from high decile schools in the pre-EQ and original descriptive (Study 1 v. Study 2), but there were significantly more in the high decile schools (deciles 7-10) in the replication group (Study 4). Within the replication study, the non-strategy contrast schools were almost entirely children in high decile schools (Table 4).

Table 4 Characteristics of school-age children in four study groups at Time 1

Characteristic		Study 1 Pre-Earthquake	Study 2 EQ-Exposed Children	Study 3 Strategy Study			Study 4 Strategy Replication Study		
				Strategy	Contrast 1	Contrast 2	All Replication Schools	Strategy Replication	Contrast Replication
N Study Children		298	306	224	47	89	975	727	248
School Decile %	Low (1-3)	36.7	23.1	27.4 *		100	14.3***	11.8	22.4†††
	Mid (4-6)	28.6	37.9	45.2 ***			37.6**	49.0	0.0†††
	High (7-10)	34.7	38.9	27.4	100		48.1***	39.2	77.6% †††
Gender (%)	Girls	50.8	47.4	49.0	38.3	39.0	45.4	47.3	39.6
	Boy	49.2	52.6	51.0	61.7	60.7	54.6	52.7	60.4†
Priority Ethnicity %		20.2	19.9	23.2	5	57	20.9% 2	17.2	
Age (years)	Range	4.8-5.3	5.0-6.3	5.0-8.75	5-8	5-12	5-15	5-13	
	Mean (SD)	5.02 (0.08)	5.22 (.27)	6.52 (.79)***	6.9 (4.28)	8.81 (2.08)	8.42 (2.45)***	8.19 (2.25)	9.06 (2.90) †††
School Year %	NE/1	100%	100%	53.2	-	14.6	16.1	16.6	14.7
	Year 2			30.6	47.7	15.7	13.8	15.1	10.3
	Year 3			16.2	52.3	13.5	13.9	14.7	11.8
	Year 4					12.4	12.0	11.6	13.2
	Year 5					10.1	13.3	14.2	10.7
	Year 6					19.1	12.8	13.3	11.4
	Year 7					14.6	7.3	7.8	5.6
	Year 8						7.7	6.8	10.3
	Above						3.0	-	11.8
PTS Symptom Score	Mean (SD)	1.98 (2.29)	2.73 (2.85)	2.64 (2.93)**	1.5 (2.24)	3.94 (3.12)	3.03 (3.06)	3.09 (3.07)	2.88 (3.02)
	Clinical %	8.8	19.3%	17.9**	11.1	30.3	22.3	23.1	19.8

*p≤.05, **p≤.01, ***p≤.001 (statistical comparisons are Pre-EQ to Study 3 Strategy Schools at T1, and Study 3 Schools to Study 4 Schools
† p≤.05, ††p≤.01, †††p≤.001 (statistical comparisons are Replication Strategy Schools to Replication Contrast Schools

Gender

In all study groups, except the pre-earthquake study, there were more boys than girls (Table 4), but these differences were not statistically significant, except that there were significant differences between the strategy group and the non-strategy contrast group within the replication study. These rates similar to the Canterbury region which has 50.66% boys (Education Counts, 2018).

Priority Ethnicity

The proportion of Maori and Pacific Island children represents "priority ethnicity" as determined by the Ministry of Education and the Ministry of Health. The proportion of priority ethnicity for each study group (Table 4) was determined from per-pupil demographic data for the pre-earthquake and original study schools and was 20.2% and 23.6%, respectively (not significantly different). However, although the overall proportion of priority ethnicity in the Replication Schools at baseline was also similar, in the strategy schools within this group, the priority ethnicity was significantly fewer (17.2%).

In 2015, 15.6% of the national population was Maori (Statistics New Zealand, 2015). In Canterbury, of the 96,489 children in primary and secondary school in 2018 (excluding kindergarten and preschool), 18.86% were of priority ethnicity in the July roll (Education Counts, 2018). Therefore, it appears that the pre-EQ and original strategy groups generally over-represent priority ethnicity as compared to the Canterbury region. However, there are fewer children of priority ethnicity estimated within the replication strategies study group as compared to the Canterbury average.

Implications. Data and conclusions from the pre-EQ and original strategy schools are likely to represent the Canterbury population as a whole in terms of general demographic characteristics. However, since children with priority ethnicity are at increased risk for PTS symptoms, and there are fewer children with priority ethnicity in the replication group as compared with the population, there is a potential that the results in the Replication Strategy Schools are not representative to the priority ethnicity groups in the Canterbury community.

Age and Year Levels

The Pre-Earthquakes study (Study 1) enrolled five-year-old children as they started school in 2005-2007 (Liberty et al., 2010; Liberty et al., 2016). The PTS scores of children at school entry were used in a comparison between the earthquake-exposed children starting school (Study 2) and the pre-EQ study (Liberty et al., 2016; Liberty, 2017).

In the Strategy Study (Study 3), children were enrolled in years NE-3 at the baseline measure pre-strategy and had an average age of about 6 years (Table 4). However, the replication schools in Study 4 included children across all year levels and had a significantly older average age of about 8 years ($t=11.4907$, $df=1399$, $p<.0001$).

Children with Clinical PTS at Baseline

Children with 6 or more of 10 symptoms of post-traumatic stress reported by teachers were identified as having a clinical-level of PTS at baseline.

In the pre-earthquake study, rates of clinical PTS were 8.8% (Table 4), which is within the typical range for children in a non-disaster affected community (Alisic et al., 2014; DeBellis, & Zisk, 2014).

There were 17.9% of the continuing study children at the original strategy schools with clinical-levels of PTS at the strategy study baseline, significantly more than in the Pre-EQ study (Table 4), and the overall mean PTS score was significantly higher than in the pre-EQ group. These rates are similar to those reported following other earthquakes (e.g., Jin, Deng, An & Xu, 2019; Su, Chou, Ou-Yang & Chou, 2006).

Although there were no significant statistical differences between the proportion of children with clinical symptoms at Time 1 (T1) or the mean symptom score between the original study group and the replication study groups. Children in the replication schools have higher rates of clinical PTS as compared to the original study schools. This difference might have been related to the exposure to additional natural disasters occurring in 2016 and 2017, including the Kaikoura/North Canterbury earthquakes and the Port-Hills bush fire. The difference might also be due to exposure to additional adverse events within the families of children attending the replication schools during the period between 2015 (Time 1 for Study 3) and 2017/2018 (Time 1 for Study 4).

Preschool and Kindergarten Children in Study 4

Studies 1-3 did not involve preschools or kindergartens. However, as primary schools discussed the results of the initial strategy implementation, preschools and kindergartens reported that they were experiencing some of the same issues with the children in their centres. After some exploratory discussions, 12 preschools and 6 kindergartens whose children were likely to enrol in the replication schools volunteered to participate.

The total roll of the 18 organisations was 726. Preschools randomly identified a very high percentage of their roll for study participation (Table 5), and kindergartens also recruited children at higher rates than schools participating in Study 4 (Tables 4 and 5). The total number of children at baseline was 432 (59.5% of the total roll). Both preschools and kindergartens reported more boys than girls in the study groups.

The estimated rates of children with clinical PTS symptoms showing very low self-regulation were similar to those in schools.

Table 5 Characteristics of preschool and kindergarten participants in Study 4

Characteristic	Replication Preschools	Replication Kindergartens
Number of Schools	12	6
Total School Roll	498	228
N Study Children	342	90
% Total Roll	68.7	39.5
% Girls	47.8	43.3
% Boys	52.2	56.7
Study Children Age Range	2-5	2-4
Mean Age (SD)	3.83 (.67)	3.13 (.66)
% Any PTS Symptoms T1	66.1[3]	51.2
% Clinical PTS Symptoms T1	27.0 [4]	15.6

Characteristics of Children with Clinical PTS

As the strategies were aimed at reducing the number and impact of PTS symptoms in children with the highest symptom rates, the clinical groups, it is important to consider the characteristics of these children at the baseline.

There were no significant differences across study groups in the clinical children's mean PTS score (Table 6).

Gender

In the pre-EQ study, there were few children with PTS symptoms, and there were no statistically significant differences by gender. However, in the original strategy group, boys were significantly more likely to be identified with clinical PTS as compared with the pre-EQ study, and boys in the replication strategy group were more likely to be identified as clinical PTS as compared to the original strategies group.

Gender differences were not significant in the pre-EQ group (possibly due to low numbers), but were significantly different within the original strategies group ($p=.05$) and the replication strategies group ($p>.001$).

Ethnicity

In the pre-EQ study (Study 1), there were no statistically significant differences by ethnicity, possibly due to low numbers (Table 6). However, in the original strategies study (Study 3), a significantly higher proportion of children of priority ethnicity identified with clinical-level PTS as compared to the pre-EQ group (Table 6). There also were significantly more children of priority ethnicity with clinical PTS as compared to the other ethnicities ($p=.001$). Ethnicity data for children from the replication schools was not available.

Between the 2006 census and the 2013 census, Christchurch lost 2% of its overall population. The largest losses (upwards of 40%) were experienced in the eastern parts of the city, the parts of the city most affected by the earthquakes (Statistics New Zealand, 2015), and also the parts of the city from which the study groups were drawn.

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Table 6 Characteristics of school children with clinical-level PTS in study groups.

Characteristic		Study 1 Pre-Earthquake N=297	Study 2 EQ-Exposed N=306	Study 3 Strategies N=224	Study 3 Contrast Schools N=140	Study 4 Replication Strategy N=727	Study 4 Replication Contrast N=248
PTS Score (0-10)	Mean (SD)	7.19 (1.32)	7.58 (1.26)	7.75 (1.48)	7.84 (1.24)	7.80 (1.43)	7.98 (1.36)
Gender	% Boys	11.0	21.1	22.4*	29.8%	28.8***	22.1
	% Girls	6.7	17.2	13.1	11.5%	16.2	16.2
Ethnicity	% Priority	11.9	23.0	36.4***			
	% Other	8.1	18.4	13.4			
Neighbourhood Deprivation							
	% High (Low SES)	11.0	26.0	22.7*			
	% Mid	8.2	9.6	13.6			
	% Low (High SES)	6.3	24.5	18.6*			
School Decile							
	% Low (1-3)	14.0	29.6	27.5*	30.3%	29.5	19.7
	% Mid (4-6)	5.9	6.9	15.8*		19.1	-
	% High (7-10)	5.8	25.2	14.1	8.5%	27.7*	19.8
School Year	% Year NE/1	8.8	19.3	13.6	36.4	17.2	8.8
	% Year 2			19.1	18.9	20.9	35.7
	% Year 3			30.6	5.6	23.0	25.0
	% Year 4				27.3	19.3	30.3
	% Year 5				11.1	31.8	13.0
	% Year 6				35.3	22.5	9.7
	% Year 7				61.5	21.7	12.5
	% Year 8				-	32.7	8.7
	% Above					-	28.6

*p≤.05, **p≤.01, ***p≤.001 (statistical comparisons are between Clinical and Other Children

Regarding cultural or ethnic identity, 83.9% of the respondents to the 2013 census identified as European, 7.9% as Asian (6.7% in 2002), 2.6% as Pacific Island (2.4% in 2006). In addition, between the 2006 and 2013 census, the number of Māori living in the wider Christchurch area increased by 12%, to 8.2% (Statistics New Zealand, 2015). In comparison, study groups had significantly more Māori children and fewer European and Asian children as compared with the city as a whole.

However, overall in New Zealand, 74% of people identify as European and 15% as Māori. Thus, the demographics in both samples in terms of cultural and/or ethnic identity are somewhat equivalent to the demographics of the country as a whole.

Socioeconomic Status

Children from low socio-economic (SES) neighbourhoods are at increased risk of PTS symptoms in the general population, and, in the pre-EQ study, there were more children from such neighbourhoods with clinical-level PTS as compared with children from mid- and high-socio-economic neighbourhoods (Table 4). Although children from low SES neighbourhoods attend low-, mid- and high- decile schools, schools with a preponderance of children from low-SES neighbourhoods are identified as low decile schools. In the pre-EQ study, the pattern of more children with clinical PTS in the low decile schools as compared to the mid- and high-decile schools mimics the pattern for the neighbourhoods (Table 4).

However, in the replication strategy group, a different pattern is seen (Figure 14), in which the rates in low and high-decile schools are similar, with the lowest rates in the mid-decile schools. Although there are no children from mid-decile schools in the replication contrast group, the rates for the low and high decile contrast schools are equivalent and show the same pattern as the replication schools overall.

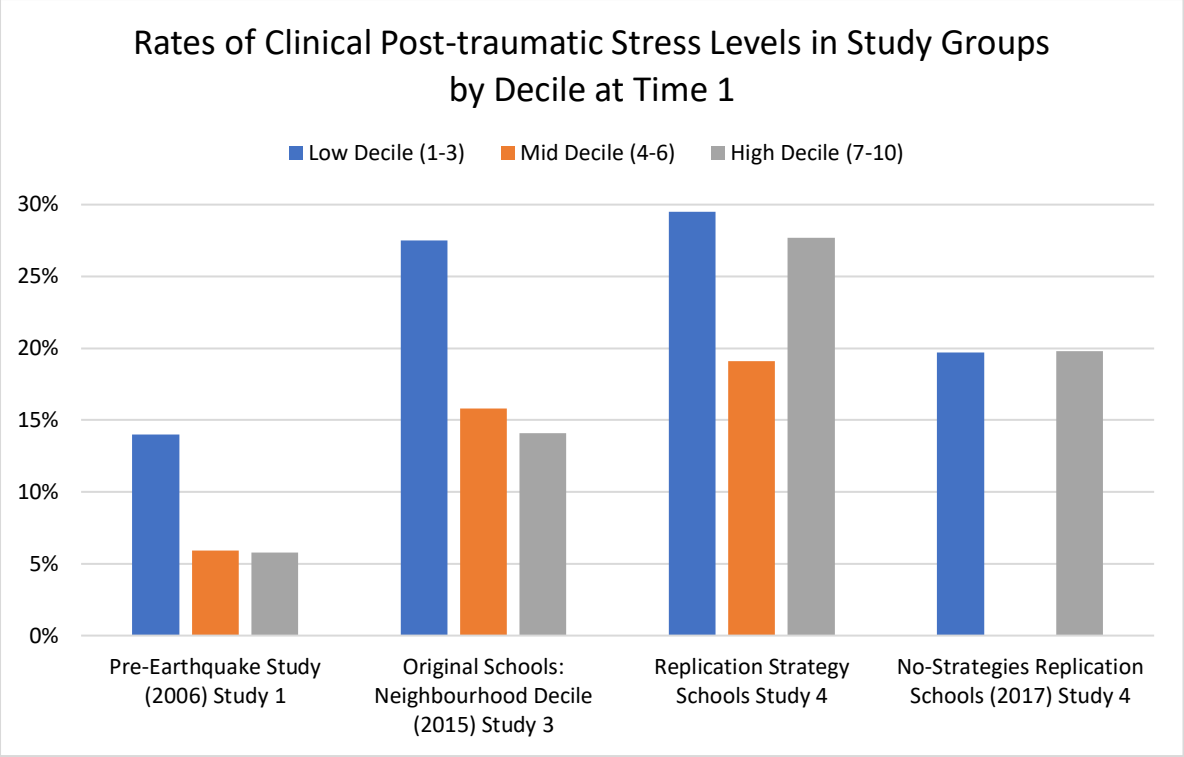

Figure 14 Participants with clinical-level symptoms at T1 before strategies by school decile

Implications. In Study 1 and Study 3, children attending low-decile schools had higher rates of clinical PTS, but in the replication schools in Study 4, children from high- decile schools had rates similar to low-decile groups. What might explain the reason for the increase in the proportion of children with clinical PTS from high-decile schools?

It may be that children attending high-decile schools might have a delayed onset of high PTS symptoms, due to protective factors associated with a higher family income or other similar factors which delayed onset. Research indicates that PTS symptoms, once identified, persist or increase over time as the child is exposed to additional adverse events (Dunn et al., 2019) or has fewer social supports (La Greca et al, 2013). Adverse events affecting families, such as delayed home insurance settlements, might have disproportionately affected families of children attending high-decile schools. As fewer details are available for children in the replication groups, it is not possible to conclusively identify the source of the differences.

Relationship of Child PTS Symptoms to Earthquake Exposure

Exposure to Earthquakes and Post-Earthquake Stressors

Detailed information available from participants at the original study schools identifies their exposure to events associated with the extended period of earthquakes, and our previous research demonstrates that the increased prevalence of PTS symptoms is associated with exposure to the extended period of earthquakes and their subsequent adverse events affecting families, schools and communities (Liberty et al, 2016). This information is not available for the replication groups.

Four of the earthquakes with the largest magnitude over a period of 16 months were identified as indicators of extended earthquake exposure (Table 7). Approximately 99% of the children were exposed to either or both the 4 September 2010 earthquake (M7.1) and the 22 February 2011 Earthquake (M6.3), and all children continued living in Christchurch until school entry (inclusion criteria). Children who were not living in Christchurch and/or experienced fewer than two of the earthquakes were excluded from the analysis.

Table 7 Exposure to indicator earthquake stressors in clinical and non-clinical children.

Earthquake Exposure Factors	% Overall	% Clinical	% Other Children
% Experiencing Indicator Earthquakes			
Saturday 4 September 2010 (4:20 am)+	92.11	85.2	93.5
Tuesday 22 February 2011 (12:51 pm)	93.78	92.6	93.5
Monday 13 June 2011 (2:20 pm)	97.38	100.0	96.7
Friday 23 December 2011 (3:18 pm)	74.47	92.6	86.3
All four indicator earthquakes+	*75.00*	*74.07*	*75.1*
% Separated from parents at one or more of indicator earthquakes++	62.3%	61.3%	62.5%
Age in months: 22 February 2011 EQ Mean (SD)	21.03 (9.43)	23.68 (10.12)	20.46 * (9.21)

+Excluding children not yet born in September 2011. ++ Children separated from their parents at one or more earthquakes were significantly older (p>.001) and more likely to be attending preschool for the earthquakes that occurred during the day. * p≤.05; ** p≤.01, **p≤.001

There was no statistically significant difference in the number of earthquakes to which children were exposed between the children with the clinical-level of PTS or whether or not they were with their parents at the time of the earthquakes (Table 7). The mean age at the time of the 22

February 2011 earthquakes was 21 months and children with clinical PTS at baseline were three months older at the time, and this was the only statistically significant difference between children later identified with clinical PTS at baseline and those who were not identified as clinical PTS at baseline.

Exposure to specific events in post-disaster periods, such as experiencing an injury or spending time in a shelter, has been associated with PTS symptom severity, and an exposure assessment was completed by parents to assess these factors in the original study group (Table 8). Children later identified with clinical PTS at baseline were more likely to have been injured during an earthquake, or to have known someone who was injured or died (Table 8).

Table 8 Earthquake exposure in clinical and sub-clinical PTS symptom groups.

	Severity of Exposure Factors	Total	Clinical	Other
1	% Child injured during earthquakes	1.6	7.4	0.6 **
2	% Child knew someone who was injured or died	9.8	25.9	7.1 ***
3	% Child lived in house damaged	63.7	70.4	62.5
4	% Child experienced falling objects during EQ	83.6	92.6	82.1
5	% Child experienced loss of services such as electricity, water, sewage for one month or more	94.6	96.3	94.3
6	% Child spent time in a shelter	1.1%	0	1.3
7	% Portaloo for 1 month or more	14.1	25.9	12.1
8	% Preschool closed for 1 month or more	32.8	40.7	31.4
9	% Had to change preschools	18.5	26.9	17.1
10	% Child friends moved away	30.6	40.7	28.2
11	% Friends or relatives came to stay for one month or more	21.2	48.1	16.6***
12	% Change place of child sleep for one month or more	38.6	66.7	33.8***
13	% Family high stress	51.1%	66.7	48.4**
	Total Exposure Severity Score (13 items above) Mean (SD)	4.55 (2.2)	6.07 (2.37)	4.29*** (2.08)
	% Change in parent composition following EQs+	16.3	29.6	14.0
	% Family lived on severe EQ-damaged land (TC3)	17.2	9.8	18.7
	% Family moved for one-month or more	37.9	35.5	38.3

+ For example, parents separated; parent with new partner; etc.* p≤.05; ** p≤.01, **p≤.001

They were also more likely to have lived with families that had friends or relatives come to stay for a month or more, and had changes to where they slept ("displacement"). Significantly,

66.7% of children whose parent/caregiver reported high family stress had high PTS symptoms at baseline, as compared to 48.4% of children who had below clinical-level symptoms.

Children with clinical PTS at baseline experienced significantly more of the 13 factors as compared to children with lower symptom scores (Table 8).

Sleep and Somatic Symptoms of Stress in Children

Traumatic stress results in physiological changes to the autonomic nervous system, the central nervous system, and may affect many different physiological functions (Perry et al, 1997). These changes comprise physical markers of stress in the body (c.f., "somatic symptoms") and include impacts on heart rate and long-term heart health, immune system, digestive and excretion systems, neurological development and structure, and so forth (Gupta, 2013).

Parents reported on children's sleep and somatic symptoms during the baseline studies. Children who experienced the earthquakes, as compared to the pre-EQ group, were far more likely to have sleep problems and somatic symptoms (Table 9).

Table 9 Sleep and somatic stress symptoms in Pre-EQ (Study 1) and EQ- Exposed (Study 2) children.

Somatic Problem	Pre-EQ	EQ-Exposed
Trouble going to sleep	11.4%	26.5 ***
Nightmares	18.8%	40.7% ***
Bedtime fear	3% †	35.4% ††***
Waking in the middle of the night	17.8%	45.6% ***
Wetting the bed	27.2%	31.4%
Any sleep problem	36.9%	70.8% ***
Changes in eating or eating problems	9.7%	12.8%
Headaches	3.4%	17.7% ***
Stomach aches	9.7%	35.4% ***
Ear Infection	12.1%	20.8% **

* p≤.05, **p≤.01, *** p≤.001 †Fear of going to bed ††Fear of sleeping alone

Within the earthquake group, more children with clinical-level PTS symptoms had sleep and somatic problems as compared to children with lower levels of PTS symptoms (Table 10),

including twice as many with sleep problems. However, it is important to note that the overall number of problems in the EQ-exposed group is much greater.

Table 10 Sleep quality and somatic symptoms.

	Somatic Symptoms	Total EQ-Children	Clinical	Other
	% Any sleep problem	70.8	90.3	67.7**
1	% Trouble going to sleep	26.5	38.7	24.6
2	% Nightmares	40.7	51.6	39.0
3	% Fear of sleeping alone	35.4	54.8	32.3**
4	% Wake in the middle of the night	45.6	71.0	41.5**
5	% Wet or soiled bed	31.4	45.2	29.2
	% Any somatic problem	83.2	93.5	81.5
6	% Changes to eating, weight-loss/gain	12.8	22.6	11.3
7	% Headaches	17.7	38.7	14.4***
8	% Stomach aches	35.4	48.4	33.3
9	% Ear infection	20.8	41.9	17.4**
	% Any somatic or sleep problem	83.2	93.5	81.5
10	% Speech or language problem	7.5	16.1	6.2*
	Somatic Symptoms	Mean (SD)	Mean (SD)	Mean (SD)
	Sleep Problems	1.80 (1.54)	2.61 (1.45)	1.67 *** (1.52)
	Somatic Problems	3.10 (2.47)	5.00 (2.81)	2.80 *** (2.27)
	Total Problems	4.90 (3.87)	7.61 (4.09)	4.47 *** (3.67)

Exposure to multiple factors associated with later PTS symptoms is significantly higher in the clinical group, and this increased exposure is the most likely explanation for the significantly higher PTS symptom score, in particular, the increase in arousal symptoms and sleep problems in the strategy group as compared with the pre-EQ group (and discussed in Liberty, et al., 2016; Liberty, 2017).

Estimated DSM-5 Child PTSD Diagnostic Criteria

At baseline, considering all of the children, more than half of the children met the criteria for intrusion in all of the study groups, and only about 40% met none of the criteria (Table 11). There were no statistically significant differences between the groups.

In terms of the functional impact of symptoms, relating to criterion [G], at baseline, there was a significant negative relationship ($p<.001$) between meeting DSM-5 symptom criteria and meeting all of the national standards in the original strategy schools, the replication strategy schools and the contrast schools. The fewer the DSM-5 criteria met, the better the rate of meeting all three of the national standards (Figure 15), because experiencing adverse experiences such as earthquakes can reduce school success (Porche et al., 2016; Walsh et al., 2019). As learning is an important outcome for children, difficulties learning can be considered meeting the criterion for 'impaired function" and the relationship shown in Figure 16 confirms the relationship between the presence of DSM-5 symptom criteria and impairment to learning. This analysis provides support for the relationship between learning and PTS symptoms as assessed in the reported studies.

Table 11 Estimated prevalence of DSM-5 Child PTSD symptom criteria at T1 in Study 3 and Study 4 study children.

DSM-5 Symptom Criteria	Study 3	Study 4	
	Original Study Group N= 224	Replication Strategies Schools N= 844	Contrast Schools N=248
% No Symptom Criteria	40.2%	39.8%	39.1%
% Intrusion (Symptom B)	51.3	53.6	55.6
% Negative Cognitions & Moods (Symptom C/D)	24.6	28.7	27.8
% Arousal (Symptom E)	30.1	38.3	34.3
% All Symptom Criteria	17.0	20.6	19.8

(no statistically significant differences)

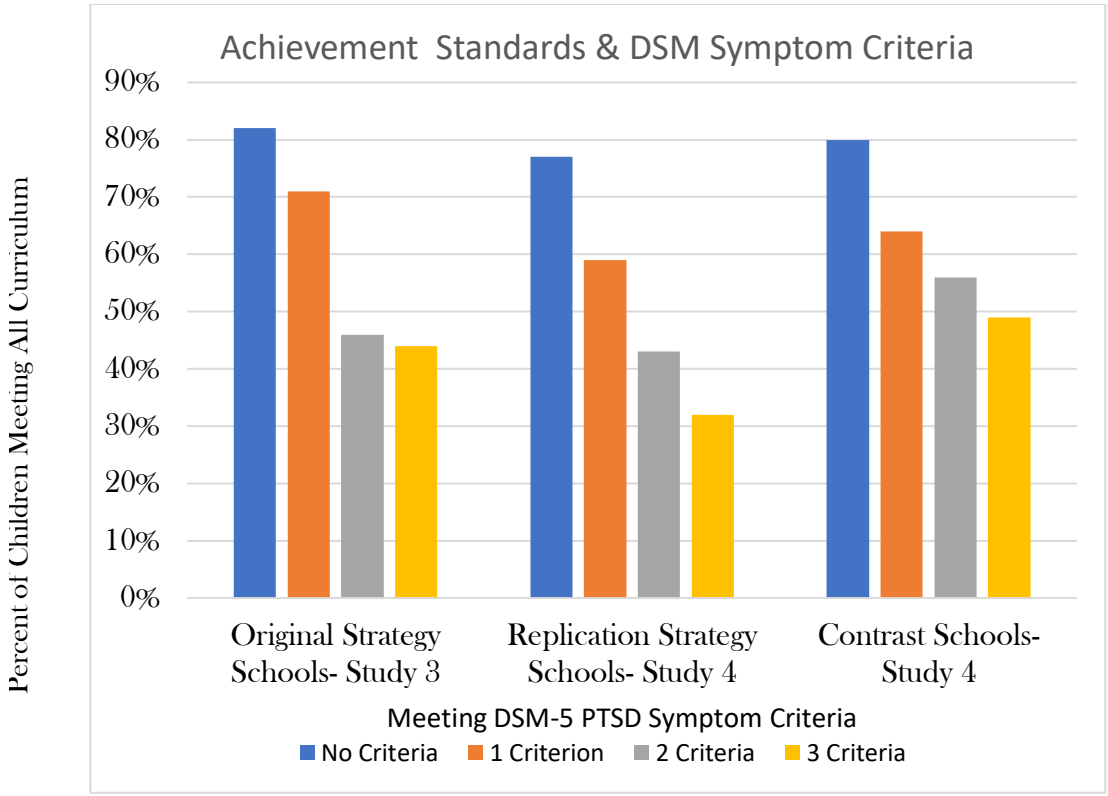

Figure 15 Relationship of DSM-5 PTSD symptoms to meeting curriculum standards at T1.

Estimated percentage of all study children meeting DSM-5 Child PTSD symptom criteria and rate of meeting all three achievement standards (reading, writing and maths) at baseline.

Although the exposure to earthquakes in the replication groups has not been recorded, the symptom rates and the relationship to learning is virtually identical to that of the original strategy schools, in which earthquake exposure has been studied. This information supports the assertion of concerning rates of PTS in the child study samples and impact on school functioning.

Patterns of PTS Symptom Change 2013-2015

There were many children with PTS symptoms in Study 2 who were followed from new entrants. By the end of 2015, children who began study participation in Term 1 of 2013 had been in the study for three school years (12 terms), while children who started in Term 4 of 2015 had been in the study for less than one term. The patterns of PTS symptom scores between project entry as new entrants (children who participated in Study 2), and scores at the end of 2015 were categorised for children who had been in school for between 3 -12 school terms (excluding children who began study 2 participation in Terms 3 and 4, 2015).

Table 12 Post-traumatic stress trajectories from Canterbury earthquakes, Hurricane Katrina, and a combined disaster.

Comparison Factor	Study 2*	Self-Brown et al. (2013)	Osofsky et al. (2015)
Number of Children	233	426	4,619
Age of Children (years)	5-8	8-16	3-18
% Low Income	37.8%	N/A	72%
Type of Disaster	Canterbury Earthquakes	Hurricane Katrina	Hurricanes and Oil Spill
Measurement Change Time Period	1-3 years (2013-2015)	3 mo. - 2 years. (2008-2010)	1-4 years (2009-2012)
PTS Symptom Trajectories			
% Low and stable (resistant)	22.9%	71%	52.1%
% Decreasing (recovery)	23.8	25.0	21.1
% Increasing (delayed/accumulated)	23.8	0.0	18.1
% High and stable (chronic)	28.1	4.0	9.1

*children who participated in Study 2 and were still attending in one of the five participating schools at the end of 2015, before any of the study strategies were introduced.

Change patterns were categorised as low and stable, decreasing, increasing (to clinical-level) or high and stable (clinical-level and above), using models from other longitudinal studies of child PTSD following a natural disaster which measured the same children at each time point, and included children in the same age range (see Table 12, from Liberty, 2017).

The pattern analysis showed that more than half of the study children had increasing symptoms or high numbers of symptoms that were persisting. These rates were much higher than reported in studies of children post-hurricanes (post-earthquake trajectories were not able to be located in the literature).

Children in the EQ-group also suffered from many somatic and sleep problems which affect their health and development, as well as their learning. Before children can be ready to learn, they need to have improved health, reduced PTS symptoms and/or strategies to cope with their symptoms and manage stressful events that they encounter.

All of this information provoked the selection of strategies and the design of the intervention programme, described in the following chapter.

CHAPTER 5. INTERVENTION STRATEGIES

Conceptualisation

Children's school success and school difficulty has been linked to experiencing adverse events and the child's mental health. (Porche, Costello & Rosen-Reynoso, 2016). The strategies were conceptualised as improving children's learning through improving their mental health.

Children's ANS Dysregulation

The literature review identified the probability of the dysregulation of children's Autonomic Nervous System and HPA Axis and this was supported by the baseline data on PTS and somatic symptoms reported above. Additional data were collected on the school schedule and the time of day that behavioural problems occurred to further identify if circadian rhythm could also be affected.

Teachers reported the times of day that were best for learning and the times of day during which behaviour problems were high in their classrooms, and their observations as to the causes of behaviour problems. Principals reported the overall schedule of the school day. These data indicated that high rates of behaviour problems occurred just before and after morning tea and lunch, and at the end of the day – times that would be predicted if the children's circadian rhythm, controlled by the ANS, was dysregulated.

Children volunteered to have finger temperatures, which can be a rough measured of stress, recorded during daily activities of individual learning and group learning (controlling for room temperature and activity). When learning in small groups, around 29% of the children were calm, and 19.4% were stressed (the other children fell in between these two levels). In contrast, of children working individually, about 38% of the children were calm and 15 % were stressed. These data indicate that more children are calmer when they are working alone, which may be because they do not need to engage with (other) children.

Stress Triggers in Classrooms

To further inform the selection of strategies, informal observations were conducted in the fourth term of 2015 to determine the presence, or absence, of environmental variables that were reported to be associated with stress and impacts on the Autonomic Nervous System as

identified in the literature review about child PTSD and also with child learning (Barrett et al, 2015).

Wall colour. Potential triggers of arousal or PTS symptoms were associated with red, orange, dark purple and similar wall colours while calming wall colours were pale blue, pale green, and, possibly, white (e.g., Gaines & Curry, 2011; Roschk et al, 2017). An observation was conducted by walking around the schools and recording wall colours, which showed that a high proportion of classroom walls were painted in dark colours, such as purple, magenta, dark blue and dark green. Also, some classrooms were painted in intense brighter colours, such as red or orange, or had a single wall that was painted an intense colour.

Room decorations. More than 90% of classrooms had decorations hanging from the ceiling, pinned to the walls, or taped to the windows. These could trigger PTS symptoms by over-stimulating visual receptors (e.g., Barrett et al, 2015), and, or, if hanging decorations moved in air currents, by triggering implicit memories of falling objects associated with earthquakes (c.f., Pourtois et al., 2013). The room decorations were observed alongside the wall colours.

Light. Light levels in classrooms affect children's activity level and learning, particularly learning to read (Wessolowski et al., 2014). A survey to estimate lighting levels in classrooms was conducted using an iPad app, Light meter by Vlad Polyanskiy. Lighting levels were too dim for learning, using Ministry of Education standards at the time and measured in the centre of the classroom, in 51.5% of the observations. Hanging decorations and the window decorations contributed to reduced light levels in the classrooms.

Room Temperature. Classroom in older schools often have no air conditioning and limited heating and insulation, and in New Zealand, the Ministry of Education guidelines were for between 20-26°C. Temperature regulation is by way of within-room heating, such as radiators, and opening windows and doors. The new school buildings have advanced levels of temperature controls. Hot and cold temperatures can affect learning and behaviour (Wargocki, et al., 2005). An iPad app was used to record room temperatures. Observations revealed that 45% of the temperature samples were not within the acceptable range.

Noise. Noise has been shown to affect child learning and behaviour, and some noise is associated with fear and arousal, and, in Christchurch, this is likely to include loud bangs, the rattling of roof tiles in the wind, or the sound of hail on metal roofs, and so on (Clark & Sörqvist, 2012; Glad et al., 2017). Children with dysregulated arousal are likely to be more

sensitive to noisy classrooms, as high noise can trigger a fear reaction, and they also will speak more loudly to be heard (Horn et al., 2017). Thus, noisy classrooms can act as a constant source of stress for children.

A noise level within the range of 35 to 40 decibels (dB) is considered to be optimum. The Ministry of Education has given 40 decibels as the level for open plan classrooms used in Innovative Learning Environments. Children's normal activities of moving around, chatting, using materials, and so forth, contribute to the noise levels in an active learning environment.

One study reported that the background noise of an empty year four classroom was 43-52 decibels, including sounds from air conditioning and traffic outside (McCarty & Rollo, 2005). When all of the children were engaged in the same quiet activity of silent reading, the sound was 45dB – barely above the background noise. However, when children were working together and talking, the sound levels were 67 to 72 dB, about 20dB above the background noise. In that environment, a teacher would need to be speaking at 77 to 87 dB to be heard, and that level is not sustainable for the human voice. (An alarm clock might be around 80 dB, and a food blender is around 88dB. By comparison, a whisper is 30dB, and normal conversation is 60-70dB. 80 dB is 8 times greater than 70dB.). Thus, it also important as to the total duration of sound over about 56 dB, the level that is commonly reported when children are working quietly, and some talking is permitted/expected, and it is recommended that noise in an open classroom not be above 65dB (Shield, Greenland, & Dockrell, 2010).

Noisy classrooms can affect reading levels, and even a 5dB reduction in noise can improve beginning reading (Maxwell & Evans, 2000). Noisy classrooms can also reduce children's ability to work together and inhibit more complex conversational interactions – thus affecting some of the key aims of innovative learning environments.

Noise levels were estimated using an iPad app, SPLnFFT Noise Meter). The average decibel level was 66dB and ranged from: 49-80.6dB. The range of averages across the schools was between 61 and 71 decibels, although the measurement was not necessarily reliable, and did not take in to account the ambient noise levels when the classroom was empty. However, it is important to note that an earlier study in New Zealand identified that more than 40% of primary children's ability to accurately identify speech in a classroom fell below 50% in classrooms with that noise level (Valentine & Wilson, 2002). Therefore, noise levels in Strategy

School classrooms may be contributing to under-achievement and are likely to contribute to high levels of stress in the classrooms.

Strategy Steps

The introduction of the strategies was conceptualised as the three-step process. A sequential approach to adult symptoms has been recommended, but no long-term sequential approach has been reported for children (Cloitre et al., 2011). The first strategies aimed to reduce the overall arousal levels in the classroom, as demonstrated by the baseline data and improve teacher well-being, as shown through teacher and parent interview, and anecdotal reports.

The second step for schools with positive results from Step 1 strategies would be to continue these strategies, and additional strategies to reduce stress would be recommended. After calmer classrooms were established, teachers would be trained in resilience facilitation procedures, adapted from the University of Pennsylvania's Penn Resilience Programme developed for children eight years and older. The Reaching IN . . . Reaching OUT Resiliency Skills Training Programme (RIRO) has been specifically designed to help service providers who work with young children build resilience and coping skills personally and in the children they serve (Hall, 2014; Hall & Pearson, 2003; Pearson & Hall, 2017). The second planned strategy was to improve children's sleep through a sleep education programme. Quality sleep is a requirement for memory consolidation and learning. These two strategies were designed to further enhance the children's wellbeing, carrying on from the first set of strategies.

The third step involved schools continuing to implement step one and step two strategies. The calm environment that would have been established at this time – if the step one and step two strategies were effective – would be maintained, and classroom interventions to teach children positive coping skills would be implemented to improve self-regulation. That is, teaching children how to control their own behaviour, how to solve problems without resorting to reactive or negative coping strategies, and how to help peers when they [the peers] are stressed. For example, children need to learn how to deal with other children who are unpredictable, and how to modulate their own responses. Step three interventions were planned to be implemented following the effects of RIRO and the sleep education programme.

Strategy Selection

The inclusion criteria for strategies were that the procedures of the Reducing Stress project were complex. In this section, the intended bases for identifying strategies to comprise the intervention are described.

Scientific and Neuro-Biological Basis

It was of prime importance that each strategy has an evidence-base in the peer-reviewed research literature published in reputable scientific journals. This evidence base should additionally:

(1) be age and developmentally appropriate;

(2) fit with the health promotion and prevention approach by promoting wellbeing/health rather than focusing on deficits;

(3) fit with the psychological research into the effects of natural disasters on children (e.g., the research provides an outcome measure which shows improvement in a symptom of PTSD, such as inattention or irritability);

(4) match to the neurological and biological impacts of trauma on young children (e.g., dysregulation of the ANS is associated with inattention and irritability, the intervention addressed inattention and/or irritability);

(5) show that health and wellbeing were improved by the introduction of the strategy (e.g., that inattention or irritability was reduced with a good effect size).

Educational Basis

Once a potential strategy was identified, the second step was to determine its acceptability within the school and community context. There are several different aspects affecting acceptability. Briefly, these are:

(1) fit within the national bicultural context of New Zealand, as established by the Treaty of Waitangi,

(2) suit educational considerations within the context of learning in New Zealand schools at the time (e.g., National Curriculum, inclusion policy, Positive Behaviour for Learning, Ka Hikatea; national standards),

(3) be acceptable to Boards of Trustees, Principals, and teachers

(4) be do-able by teachers,

(4) be within the resource-capacity of the school.

Once strategies were identified, they were discussed with school principals and teachers, as coordinated by the principal. The strategies for the first step consisted of a package of 15 interventions identified from extant research studies.

The recommended strategies for the first step of the strategies are briefly described, with additional details in Appendix 2 and Liberty (2017).

Step One Strategies

Psychoeducation for teachers and parents

Psychoeducation is a strategy that is highly recommended for all professionals working in post-disaster communities (Shaw, Espinel & Schultz, 2012) and the first strategy recommended that professional development be provided to teachers about the effect of natural disasters and post-disaster stressors on children's behaviour and learning, in order to help them understand why children were behaving as they did, and why traditional approaches may not be effective.

Psychoeducation for parents is also essential, in particular to build understanding of post-traumatic stress symptoms and their relationship to intended strategies. It was recommended that this information be provided to parents on parent evenings, school newsletters, school Facebook pages, and similar. This information was to lay the groundwork for the other Step 1 Strategies. The provision of psychoeducation through schools has shown promise for parents of children with emotional or behavioural disorders and in understanding PTSD (Lukens & McFarlane, 2004; Pollio et al., 2005). Psychoeducation is also a positive focus, rather than a deficit focus, and emphasizes understanding and prevention and fits within the inclusive society that New Zealand is building.

The recommended intervention was information be disseminated to parents about the effect of natural disasters and post-disaster stressors on children's behaviour and learning.

Teacher and Principal Wellbeing

Child behaviour problems predict teacher stress and classroom emotional climate (Friedman-Kraus et al., 2014). The greater the number of behaviour problems, the higher the degree of teacher stress. However, teacher health and safety are a regulatory requirement for schools, and a teacher's well-being is a private matter that teachers may well not wish to discuss in their place of employment. The importance of teacher and principal wellbeing was discussed at meetings with the school leadership following baseline data collection, and it was suggested that schools seek appropriate support to address this in addition to the normal support for health and wellbeing.

Calm-Down Class Room Environments

Reduce Decorations

Recent studies have shown that classrooms that are overly decorated or cluttered, particularly with hanging objects or artwork, are associated with reduced concentration and learning for children with attention problems, as compared to classrooms with low levels of decorations (Barrett, Davies, Zhang & Barrett, 2015; Fisher, Godwin & Seltman, 2014). One of the symptoms of chronic stress is reduced attention, and highly decorated classrooms may exacerbate this problem.

One of the strategies was to remove hanging decorations. 83% of study children saw falling objects during the earthquakes, and a hanging decoration, in the child's upper peripheral vision, may trigger for intrusive thoughts, a loss of concentration or other reactions associated with posttraumatic stress. However, as classroom decorations can provide cues and information useful for learning (Imuta & Scarf, 2014), and using children's work to decorate classrooms may improve children's self-belief about the value of their work (Maxwell & Chmielewski, 2008), it was recommended to retain wall decorations that were children's work but to place these at or below the child's eye level, or , if possible, on the child's desk or worktable (e.g., number lines, alphabet letters). This would help stop children from looking up and going off task.

The overall recommendation was to remove all hanging decorations and to minimize wall decorations and place these at or below the child's eye level. Further, to improve light, remove all decorations from windows.

Improve Lighting

Light levels may affect mood, in that brighter light is associated with increased dopamine and serotonin production (Golden, Gaynes, Ekstrom, Hamer, Jacobsen, Suppes, et al., 2005); serotonin is also hypothesised to have an important role in the overall functioning of the autonomic nervous system (Grider, Bertrand & Bornstein, 2017). Sitting next to the window on a sunny day will provide more than the 1000-lux of bright light that is associated with full alertness and better moods. Dim light may reduce hyperarousal levels and may also signal 'sleep' to the autonomic nervous systems of tired children and teachers noted that turning off the lights or pulling the curtains across windows were sometimes used to quieten class activity.

However, dim light is not suitable for optimum learning (Sleegers, Moolenaar, Galetzk, Pruyn, Sarroukh, & van der Zande, 2013). The lux level needed for reading, writing, and tasks at desks or tables and for listening to teachers has been reported at 300 lux in research studies and this is the standard for learning set by the New Zealand Ministry of Education. Focus lighting of 1000 lux at desk level has been shown to improve the reading of children in USA grade 3 who are struggling (Mott, Robinson, Williams-Black, & McClelland, 2014).

Considering the overall level of light in about the centre of the classrooms, 51.5% of the observations were not in the acceptable range – with light that was too dim for learning. However, the effect of shadow must also be taken into effect, for instance, children sitting with their backs to the window, with lights directly overhead or to the rear, will be casting shadows on their own work, creating a micro-space of dim light.

The recommended interventions were to (1) remove decorations from windows (2) seat children with learning problems near the window during instruction to increase the lux available for their learning opportunity, (3) open curtains during instructional sessions and (4) turn on lights during instructional sessions.

Reduce Noise

Noisy classrooms reduce children's learning and collaboration (Maxwell & Evans, 2000; Mealings, Buchholz, Demuth & Dillon, 2015; McKellin, Shahin, Hodgson, Jamieson, &

Pichora-Fuller, 2011). Children with PTS symptoms are likely to be more sensitive to noisy classrooms, as high noise can trigger a fear reaction, and they also will speak more loudly to be heard. A noisy classroom is very stressful for teachers, as well, because the teacher must speak an average of 10 decibels louder than the class to be heard, so noise levels can rise quickly. A noise level within the range of 35 to 40 decibels is considered to be optimum by the Ministry of Education. (In the Strategies classrooms, the range of mean noise levels across the schools at baseline was between 61 and 71 decibels.

The recommended intervention was to reduce noise using a freely available app, "Too Noisy Pro", (https://toonoisyapp.com/), which could be displayed in each classroom although only anecdotal evidence was available to support this intervention. Other possibilities, were considered for new builds, such as installing noise cancelling wall panels to meet new Ministry requirements, or using a "whisper classroom" strategy.

Wall Colour

Studies that have evaluated wall colour have reported that children's achievement is lower in red-painted rooms compared with green rooms (Elliot & Maier, 2012) and that children feel more excited in red and purple conditions (Brooker & Franklin, 2015). Pale blue has been associated with lower levels of arousal (Küller & Janssens, 2009).

It was recommended that wall colours be changed to a pale blue using a paper covering, if possible, as intense and dark colours, including red and purple, can increase arousal levels.

Play-Eat-Learn

One aspect of the autonomic nervous system that is disrupted by chronic stress is circadian rhythm – the 'body clock' (Rees, 2014). According to the principals of our Strategy schools, the general timetable begins with some children arriving at school from 8 o'clock, and school starting at 9 o'clock. The times of day that teachers find the most and least productive for learning were determined through the interviews. There was a consensus that the best times for learning were approximately between 9 and 11:30 in the morning, although some teachers commented that some children are already upset and frazzled by the time school begins. The most difficult times for classroom behaviour were following morning tea time and lunch breaks, and late afternoons, before the end of the school day at 3 pm. A common trigger was that behaviour was affected by conflict and excitement in the playground during play times in the morning (after morning tea) and at play time after lunch, and, "this spills over into the

classroom". Other teachers explained behaviour problems and identified why these occurred. Here are some of their explanations: "children are tired and have done a lot already" [at the time behaviour problems occur], "children may not have eaten enough lunch, as some [eat a lot of the food sent with them to school by their parents] at morning teatime and don't have enough to eat at lunch"; "there are low energy levels and high arousal" "issues arising on the playground", "hot or raining weather", and "large gaps between eating times."

Traditionally, morning teatime and lunch include a period set aside to eat followed by time to play, typically followed by a set period for instruction and learning. Circadian rhythm is affected by the time of day that eating occurs, and sufficient energy from food is needed for learning. According to Getlinger and colleagues (1996), "It is crucial that children of primary school age receive adequate meals to eliminate transient hunger, which may interfere with classroom performance. Proper nutrition has been linked to readiness to learn, decreases in discipline problems, and increased alertness in the classrooms." Thus, one important environmental context was the schedule for children to eat in relation to the schedule for children's learning.

Playtime is vital to children's development and learning, and having play breaks during the school day can improve children's thinking, appetite and learning. However, physical activity and eating are also body functions of the autonomic nervous system, and, in children with post-traumatic stress symptoms, these functions are highly likely to be dysregulated (Gupta, 2013; Rees, 2014). The dysregulation of the autonomic nervous system associated with PTSD means that appetite and the processing of food by the body are also affected. PTS can affect the digestion and processing of nutritional food (Chrousos, 2009; Van der Kolk, 2004; Zhang et al., 2015). It is estimated that about 87% of New Zealand school children eat a healthy breakfast before school while 13% do not (Ministry of Health, 2013) Children who miss breakfast, or children who have dysregulated autonomic nervous systems may be missing out on the food necessary to sustain attention and maintain control over their behaviour (Adolphus et al., 2013; Wesnes, Pincock, Richardson, Helm, & Hails, 2003). One approach to assisting in the healthy re-regulation of the autonomic nervous system may be to align the activity and eating functions with normal body rhythms (Yoshizaki, et al., 2013), a form of chronotherapy.

The identification of problems associated with possible relationships between scheduled eating times and behaviour problems provides a key factor in understanding the context in which behavioural problems were occurring in the Strategy Schools. Research indicates that the

circadian rhythm affects cognition, memory and attention (Schmidt, Collette, Cajochen, & Peigneux, 2007), so adjusting the school schedule to align to a healthy circadian rhythm was the basis of Play-Eat-Learn, and based on research from the USA, where a similar strategy is called *Recess First, Reverse Recess* or *Recess Before Lunch,* and is often aimed at reducing waste in the school-provided hot lunch programmes. However, Play-Eat-Learn is used to structure food-intake, play and learning activities throughout the school day, and was designed to promote attention and reduce behaviour problems during learning periods.

Play-Eat-Learn does not reduce play time in the school day, it reschedules it. Having play breaks during the school day can improve children's thinking, appetite and learning. However, physical activity and eating are also body functions of the autonomic nervous system, and, in children with post-traumatic stress symptoms, these functions are highly likely to be dysregulated (Gupta, 2013; Rees, 2014). The dysregulation of the autonomic nervous system associated with PTSD means that appetite and the processing of food by the body are also affected. PTS can affect the digestion and processing of nutritional food. Children who miss breakfast or children who have dysregulated autonomic nervous systems may be missing out on the food necessary to sustain attention and maintain control over their behaviour.

Research shows that changing the order of playtime and lunch results in more food being eaten, a calmer lunch atmosphere, a dramatic decrease in disciplinary problems and improvement in children's ability to pay attention in classrooms. This may be because the children are no longer rushing their lunch to get out to the playfields to meet up with friends or to claim a particularly desirable piece of play equipment, or a similar reason.

The recommended intervention involved changing the schedule of the school day – reversing the order of eating and playing for morning tea and lunch, scheduling eating at about 90-minute intervals, and scheduling learning of key skills directly after eating (Figure 16). All schools required two or three adjustments to the school timetable to make PEL work within their school day plans.

Time of Day	Location	Activity	P E L
7-8:55	Before School Routine	Home	Play Eat Play
8.55-9:20	School begins	Karakia, Hui	Learn
9.20-9.30	In class	Morning snack (Milk and complex carbs)	Eat
9.30-11:00	In class	Reading and Writing	Learn
11am-11.15	Outside	Morning play time	Play
11.15-11.25	In class	Morning tea *Child's own food	Eat
11.25-12.45	In class	Maths	Learn
12.45-1.15	Outside	Lunch play time	Play
1.15-1.30	In class	Lunch *Child's own food	Eat
1.30-2.45	In class	Maths/Topic/Art etc.	Learn

Figure 16 Sample Play-Eat-Learn timetable

As part of the application of the Play-Eat-Learn timetable, it also became necessary to ensure that the first "eat" included food that would sustain attention because children may not have breakfast, or may have breakfast between 7-7:30 am, they may not be able to maintain concentration and self-regulation during the first part of the school morning, particularly if they have PTS symptoms. This led to a revised schedule to include a complex carbohydrate snack to ensure children had sufficient food intake to sustain concentration during the "Learn" segments.

Ō whakatau (Complex carbohydrate snack)

Ō whakatau - a snack that has the intent of calming the brain.

The originally recommended intervention for children in the junior school was the introduction of a mid-morning snack consisting of complex carbohydrates (wholemeal bread) with dietary supplements from spreads (i.e., butter, marmite, vegemite) into the Play-Eat-Learn schedule. The composition of the recommended snack was based on nutritional analysis of foods available in the community and the composition of the food reported in the research studies.

As many children do not eat breakfast or may eat a breakfast that is high in sugar, research into improving children's health and academic achievement has studied the effect of a mid-morning

snack on children's learning (e.g., Benton & Jarvis, 2007; Smith & Wilds, 2009). These studies provide evidence that adding a high carbohydrate snack to the school day has potential benefits, particularly for children who do not eat breakfast, and for those with PTS symptoms whose digestion of foods may be affected.

The recommended intervention was the introduction of a mid-morning snack consisting of one slice of wholemeal bread (i.e. complex carbohydrates) with spreads (i.e., butter, marmite, vegemite) that contain nutrients associated with stress reduction or improvement of the immune system (which is dysregulated by stress) within the Play-Eat-Learn schedule.

Certain kinds of food improve concentration and can affect behaviour (Arnold, Hurt & Lofthouse, 2013; Benton, 2008; Micha, Rogers & Nelson, 2010):

- Complex carbohydrates take a longer time to digest and therefore are key to reducing feelings of hunger that can affect attention.
- Complex carbohydrates provide a long-lasting source of energy.
- Complex carbohydrates can help children sustain attention.
- Children who are stressed may not receive appropriate 'signals' from their autonomic nervous system that they are hungry.
- Children's need for energy from food is increased when they are having sleep problems, and stress is associated with disrupted sleep.
- "The child's brain is both relatively bigger and more active than the adult's, suggesting that children may be particularly responsive to the nature and amount of carbohydrate in their meals and the frequency of eating." (Benton & Jarvis, 2007, p.384

Multi-grain bread does not provide the same benefits, because bread with the terms multigrain, 5-grain or 7-grain don't always mean they use wholegrain in their formula. To identify appropriate bread, look at the ingredients list and ask three questions: Is the first ingredient a wholegrain? Does each slice have more than 2g of fibre? Is "inulin" or "polydextrose" present? The correct answers: Yes, yes and no. Inulin and polydextrose are two additives used to artificially boost fibre.

What we recommend: Affordable complex carbohydrates: One slice of wholemeal bread or a small wholemeal roll. We recommend serving with Marmite/Vegemite/Peanut Butter/Butter. (No margarine, no jam, no jelly.) Popcorn will provide the same high carbohydrates for children with gluten-intolerance

Suggested components.

Bread Meeting Requirements:

1. Tip Top Super Soft Toast Bread Whole-meal 700g. Ingredients: Wholegrain Wholemeal Wheat Flour (49%), Water, Wheat Flour, Bakers Yeast, Wheat Gluten, Iodised Salt, Canola Oil, Acidity Regulator (263), Soy Flour, Emulsifiers (481, 472e). 2.25 fibre/slice, 15.5 complex carbohydrates. Price Check: 17 slices + 2 crusts for $3.30 (17 cents/ child).

2. Ploughmans Bakery Toast Bread Farmhouse Wholemeal 750g. Ingredients: Wholegrain Wholemeal Wheat Flour (49%), Water, Wheat Flour, Baker's Yeast, Wheat Gluten, Iodised Salt, Vinegar, Granary Malted Wheat Flakes, Canola Oil , Wheat Bran, Wheat Germ, Cultured Dextrose, Soy Flour, Emulsifier (481, 472e). 2.8 gm fibre; 18gm complex carbohydrates. Price Check: 18 slices /crust, $3.00 (16.6 cents / slice)

Spreads Meeting Requirements

1. Marmite & Vegemite. Ingredients: Some are secret, but made from Yeast extract. Yeast Extract includes: B Vitamins & Folic Acid (associated with stress reduction, immune function and healthy brain function for cognition and short-term memory); Protein is suitable for vegetarians; Gluten-free.

Not: Recommended: Margarine contains Transfats and this will work against healthy function.)

2. Butter. Ingredients include omega 3; Vitamin K2, which promotes good gut bacteria, immune function, and metabolism. Protein (dairy), Some complex carbohydrate and fibre.

3. Peanut Butter. Ingredients include: vitamin E (for antioxidant, stress); magnesium (bones); potassium (muscles); Vitamin B6; CC (3-6 gm)

Obesity and the proposed wholemeal snack

This section was written to help a principal discuss the snack strategy with a group of parents who were worried about obesity.

"It is true that people eat when they are stressed [obesity in children is directly related to experiencing Adverse Childhood Events (Javier, Hoffman & Shah, 2019; McKelvey, Saccente, & Swindle, 2019]. Their body is dysregulated and sends signals, perhaps of the wrong kind. The signal to eat doesn't come with instructions about WHAT to eat! And yes, people do eat sugary and 'fatty' foods which do give a very short-lived feeling of things being better – this is a very common coping strategy. This does contribute to obesity as obesity is a stress-related disorder of the autonomic nervous system. However, eating only the food we recommend in our strategy (one slice of wholemeal bread with peanut butter, butter, or Marmite/Vegemite at a specific time in the morning) will not contribute to weight gain, and will help suppress the urge to snack on unhealthy things. If this information (about the relationship between stress, adverse events, and obesity) is included in a science education programme, the children will learn the type of food that really helps their body and that the sugary fatty foods will not actually help them (the positive coping programme will help them learn different coping strategies). Telling them not to eat at all when their ANS is sending them signals about hunger just creates more stress and exacerbates the dysregulation. This may make them hide when/what they eat and feel shame and helplessness, and these emotions further dysregulate the ANS. Denying people food when their ANS is dysregulated is not a wellbeing strategy in my opinion. The timing of the snack is designed to help organise the ANS to promote health, along with the other changes to the daily schedule in Play-Eat-Learn.

"It is definitely important to teach children healthy habits. Our data indicate a majority of study children have disrupted sleep and other indicators of ANS dysfunction, including eating difficulties! [See Chapter 4, "somatic symptoms".] The research provides evidence that the biological bases of children's memories, inhibition, executive function and motor planning are disrupted due to the dysregulation of the ANS. This is why trying to teach them healthy eating habits via verbal instruction or posters or verbal reminders is not working (has not been working). Children are not able to learn, remember and then implement strategies regarding their health when their ANS is dysregulated."

Sources for this section: Baum, Petroff, Classen, Kiess, & Blüher, 2013; Bell & Zimmerman, 2010; Dallman, 2010; Fatima & Mamun, 2015; Jarrin, McGrath & Drake,

2013; Pinto-Gouveia & Matos, 2011; Scharf, Denmmer, & DeBoer, 2013; Sinha & Jastreboff, 2013; Spruyt, Molfese & Gozal, 2011).

Drink-to-Think, Think to Drink

Research has shown that children are often dehydrated, and stress particularly increases dehydration (Kenny, et al., 2015). Dehydration can affect the growth of their brain, as well as negatively affect their thinking during school Kempton et al., 2015) Many children are likely to be dehydrated following play and lunch, and dehydration can contribute to poor concentration, memory and increase impulsive behaviour. Water can be drunk with lunch, but children might still be dehydrated after lunch, as children's needs for water are different from adults' needs. When children are dehydrated, their cognitive function can be impaired. Giving children water to drink during their lessons can make an immediate and dramatic improvement in their cognitive ability as well as help them to calm down (Fuchs, Lührmann, Simpson & Dohnke, 2016).

The recommended intervention is a health education programme for teachers and children, "Drink to Think, Think to Drink", about the effects of water and dehydration on thinking and behaviour, and encouragement to drink water in the classroom, with each child and the teacher having a water bottle, and prompted to take a drink when they are upset, confused, struggling, and so forth, and to meet the recommended daily standards. The standard recommendation for children ages 5 to 8 years is 5 glasses per day (1 litre), 7 glasses (1.5 litres) for 9 to12 year-olds, and 8 to 10 glasses (2 litres) for 13+ years (Gibson-Moore, 2013; Ministry of Health, 2015).

Omega 3 Diet Supplementation

Omega 3 and Children's Learning and Behaviour

Children with severe attention problems, hyperactivity, and who are judged not to care about the emotions of others ("callous") or to be unemotional themselves have been shown to have insufficient omega 3 in their diet (Gow et al., 2013; Stephens et al, 1996). Children with dyslexia, poor health, and behaviour problems have also been identified as having low levels of omega 3 (Raine, Portnoy, Liu, Mahoomed, & Hibbeln, 2015; Richardson et al., 2000). Overall, only about 20% of the New Zealand child population is meeting the minimum recommended levels of omega 3 (Harika, Eilander, Alssema, Osendarp & Zock, 2013).

Research indicates that, on average, New Zealand children are likely to have low levels of omega 3, and this is particularly true for children with PTS symptoms.

Biological psychiatric research indicates that stress during sensitive periods of development, such as the years from 0 to 4 years, may affect the myelination of neurons (Schiavone, Colaianna & Curtis, 2015). Stressed neurons and dysregulation of the autonomic nervous system can cause the types of stress-related behaviours and health problems reported in the study children (Schuchardt, Huss, Stauss-Grabo & Hahn, 2010). In addition, stress can affect the DNA and long-term health of the individual through interruption of the myelination of neurons (Klengel, Pape, Binder & Mehta, 2014).

Good neuron connectivity is vital for emotional regulation. If children do not have good brain health, this can contribute to behaviour and body stress problems. Omega 3 is not naturally produced by the body, and is a required element for healthy brain development, particularly during the developmental period (Chang, Ke & Chen, 2009.) The New Zealand Ministry of Health identifies 55 mg of omega 3 per day as adequate intake, with an upper limit of 3000 mg per day for children aged 4-8 years. (Ministry of Health, 2012/2015; Table A4, p. 191) and increasing to 70mg per day for ages 9-13 years (Ministry of Health, 2012/2015; Table A5, page 192). There appear to be no adverse side-effects of this supplementation over the recommended time period (Ministry of Health, 2015).

Dietary supplementation with omega 3 can be an important contribution to other forms of intervention (Messamore & McNamara, 2016). Omega 3 supplementation has been shown to reduce aggression, hostility, and behaviour problems in multiple studies over more than ten years (Benton, 2007; Hibbeln, Ferguson& Blasbalg, 2006). Recent meta analysies identified that omega 3 produced can reduce aggression and behaviour problems in some children (Choy & Raine, 2018; Gajos & Beaver, 2016); improving ADHD symptoms (Bloch & Qawasimi, 2011). Recent studies have shown that omega 3 supplementation can improve sleep in some children (Richardson, 2015) and reading in young children (Johnson et al, 2017). In one blinded randomised controlled research trial of Omega-3, parents of both the Omega-3 group and the placebo group were told that the [juice] would improve behaviour. During the initial six-month period, parent-reported behaviour problems did improve in both groups, and parenting problems reduced. This result may be interpreted as showing that parenting behaviours change if they think the problem behaviour is about some issue related to their child's brain health. However, once the trial ended, only the children who actually received the

Omega-3 juice showed improved behaviour (Raine, Portnoy, Liu, Mahoomed, & Hibbeln, 2015).

Diet supplementation can be a contentious issue, and the decision to recommend diet supplementation for very stressed children is not one to be taken lightly. Even children eating a healthy diet may benefit from diet supplementation because their body stress may be affecting their digestion. This is because stressed neurons with little or thin myelin sheaths and dysregulation of the autonomic nervous system may reduce the body's ability to make use of the good healthy diets provided by parents as the autonomic nervous system affects digestion. An addition to the diet is recommended to help aid healthy neurons and benefit the health of the autonomic nervous system for children struggling with behaviour and learning issues related to exposure to adverse events.

Bi-Cultural Significance of Omega 3

Fish and other kinds of tai moana seafood were predominant in traditional Māori diets and important to overall wellbeing, Te Whare Tapa Whā. Māori traditionally ate Toheroa (paphies ventricosa), which is high in Omega-3, and many other kinds of seafood as a staple of their customary diet, but dietary changes in the 20th century, and the apparent collapse of some seafood habitats seem to have reduced fish and shellfish consumption and may have resulted in omega 3 deficiencies ((http://www.seafriends.org.nz/indepth/shellfish_collapse.htm - big_picture. Dallman, 2010; Reis, & Hibbeln, 2006). Omega 3, as part of a customary diet, is likely to be acceptable to Māori, as it is a natural seafood product.

Recommended Omega 3 Brand

Parents of selected children were invited to receive 6-12 months of Nutralife Smart Bites (Figure 17) for their child without cost, courtesy of the UC Foundation and the Rata Foundation. This product was selected since its DHA and EPA composition matched most closely those in the successful Raine et al. (2015) study. 811mg omega 3 triglyceride concentrate, 350mg Docosahexaenoic Acid (DHA) and 73 mg. Eicosapentaenoic Acid (EPA). This is made in New Zealand from 'globally sourced' ingredients. As an additional benefit, there are a number of different ways that children can consume the product (see Figures 17 and 18), and its low daily cost was important as well. Omega 3 should be stored in the refrigerator to retain its potency. The estimated cost for Omega-3 is less than a dollar a day, and it is estimated to take six months for effects to be noticed by parents and teachers.

Figure 17 NutraLife Smart Bites in 2016.

School Introduction of Omega 3 to Parents

The recommended intervention was for information about omega 3 to be disseminated to parents of children identified by the principal as having high numbers of stress-related behaviour problems. Information was discussed in meetings and/or information was put in school newsletters, or by teachers, depending on the decision of the principal of each school. For example:

> *"If you think your son/daughter could benefit from a diet supplement, the Principal at your child's school has some free bottles of Smart Bites and also has some samples that you can take home and trial. The Smart Bites must be taken every day for 6 months to begin, and up to 24 months for some children. They are good-tasting capsules that can be mixed with juice or will dissolve in the child's mouth after they are chewed. The capsule can then either be chewed and swallowed or disposed of. (The fish shaped capsules are not pills.) Please contact the School Principal for more information.*

Additional information about the potential effects of omega 3 dietary supplement on improving children's behaviour and learning was provided to the schools to use in answering parent questions.

Parents may also decide to provide the supplement privately once the information was provided to them.

If a parent took up the offer of free supplements for their child, additional information sheets were given to the parent/caregiver and their child so that they understood the reasons for taking

omega 3 (Figures 18 and 19). This information is really helpful for children. Parents are asked to discuss this information with their child, but the principal may also wish to do so. One school also used a star chart that was brought weekly to the Principal to further encourage the children to take the omega 3. Of course, children cannot be forced to take omega 3, and forcing them is likely to, add to their stress. Therefore, information was developed to help children understand the purpose of omega 3.

The idea of dietary supplementation is often more acceptable to parents rather than feeling like they are to blame for the child's behaviour. Feeling blamed is sometimes a barrier to participation in parent training programmes.

Recommending omega 3 diet supplementation can also help children understand that the problems are not 'who they are'. It can also help reinforce the idea that these problems come from a dysregulation of body systems due to stress.

Recommending omega 3 supplementation may also help change the thinking of those parents and teachers who believe the cause of the problems are due to 'naughty children." Helping these parents and teachers understand the actual cause of children's behaviour can improve empathy and reduce tension when parents/teachers attribute behaviour problems to "on purpose" responses instead of the accurate attribution of brain systems dysregulation.

Strategies)for)Juniors)Settling)into)School)and)Learning)

Ka)whangaia,)ka)tupu,)ka)puawai)
That)which)is)nurtured,)will)blossom,)then)grow)

Omega!3:!Hints!for!parents!

- Act!positive!about!taking!the!fish.!!Talk!about!'fish!time'!like!it's!an!enjoyable! thing.!Children!can!pick!up!on!negative!tone!and!body!language.!
- Give!options!of!taking!the!fish!by!chewing!the!capsule!or!cutting!it!open!and! putting!it!in!a!cup!with!juice.!
- Keep!explaining!that!the!fish!is!going!to!make!their!brain!feel!better.!
- And!don't!refer!to!medicine!as!a!lolly.!Never!do!that;!you!don't!want!them!to!seek! it!out!and!risk!overdosing,!or!thinking!that!medicine!is!a!lolly.!!Lollies!don't!make! you!feel!better.!!
- As!it!is!such!a!long!time,!you!might!need!a!reward!system.!!In!addition!to!verbal! praise,!give!kids!a!sticker!and!put!it!on!a!calendar!after!they!take!the!fish.!!They! will!feel!rewarded,!and!they!will!also!be!able!to!follow!their!progress!visually!on! the!calendar.!

If!the!child!does!not!like!the!flavour:!!!

Some!taste!deflection!tips!include!coating!the!tongue!with!syrup!or!giving!the! child!something!cold,!like!a!Popsicle,!before!they!eat!the!fish,!or!washing!away!the! taste!quickly!with!something!sweet!after!they!take!the!fish.!!

Try!putting!the!fish!in!the!fridge.!!It!might!taste!better!cold.!

Mix!it!with!juice.!!

University of Canterbury Foundation

Canterbury Primary Principals' Association

Rātā Foundation

Figure 18 Parent information sheet about omega 3 diet supplementation

Strategies for Juniors Settling into School and Learning

Ka whangaia, ka tupu, ka puawai
That which is nurtured, will blossom, then grow

This is a FISH for your brain, not your tummy.

When you were very little, earthquakes swarmed over Canterbury for about one and a half years. This is a very long time for young children.

This was while your brain was growing. Some children have noticed that their brain can feel hot or fuzzy at times.
Or like an "electric storm".
Or even jumbled up and nervous.

Some children have trouble sleeping or staying dry at night.

We don't know exactly what is going on in children's brains – that would take a lot of special equipment or some magic!

But, some scientists have found that a special kind of liquid from fish might help children's brains feel calmer.
Like they are in a cool place.

A calmer brain will be a stronger brain.
It can make it easier to sleep and to remember things and to cope with everything going on around you.

Taking ONE FISH a day might help.

We're not sure. But it could help.

But you would need to take it EVERY DAY for **183** days.

That's a lot of days!

Because your brain is so important and complicated, it can take a long time to start to feel better. That is why it takes so long. So, even if you get tired of the FISH, remember, the FISH is trying to help your brain.

Your parents are the best people to talk to about this.

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Rātā Foundation

Figure 19 Child information about omega 3 diet supplementation

Step Two Strategies

The second year of the strategies project included the continuation of the Step One strategies and the introduction of Reach In Reach Out Professional Development for teachers.

Reaching In Reaching Out {RIRO} Professional Development for Teachers

The Step Two Strategy was teacher professional development in the Reaching IN . . . Reaching OUT Resiliency Skills Training (RIRO) programme (Figure 20). Research has shown that child-teacher relationships are key to learning and achievement, and the children with behaviour problems and their teachers are more likely to have poor-quality relationships characterized by conflict, which can have long-lasting negative impacts (Lang, Marlow, Goodman, Meltzer & Ford, 2013; Nurmi, 2012).

Children with PTS symptoms are highly likely to misinterpret neutral facial expressions as negative, and, similarly, to have fear triggered by observing or receiving feedback, correction, or classroom management procedures perceived as harsh. These issues disrupt the teacher-child relationship, and disrupt children's learning, and can increase fear-related symptoms, which are common in children with PTS, who tend to have negative cognitions and impaired recognition of others facial expressions. In particular, children are more likely to see another's face as expressing anger, disgust or fear, instead of a neutral, calm or happy emotion (Cook, et al., 2017).

Teachers find instructing children affected by traumatic events to be challenging (Alsic, 2012), and this can create further stress and exacerbate a negative feedback loop between child and teacher. A positive-teacher relationship can help the reading achievement of children who come to school from low-income homes with low parent-education levels (McCormick, O'Connor & Horn, 2017). Teachers who are able to maintain positive-relationships create a positive classroom climate and feel confident and effective, and the children in these teachers' classrooms have better achievement and fewer behaviour problems (Zee & Koomen, 2016).

RIRO Resiliency Skills Training

by Jennifer Pearson

Program Developer

Training Coordinator/Master Trainer

Reaching IN...Reaching OUT (RIRO)

Developed under the auspices of Reaching IN…Reaching OUT, RIRO Resiliency Skills Training is a 12-hour evidence-based program for professionals who work with children under eight years (Hall, 2014).[1]

Adapted from more than 35 years of research at the University of Pennsylvania and the Penn Resilience Program (Reivich & Shatté, 2002), the RIRO program uses a relationship-based, cognitive-behavioural and social problem-solving approach to enhance self-regulation skills, and develop a "resilient" mindset and flexible approach to handle stress, serious problems and everyday challenges.

Since 2002, the RIRO program has helped professionals role model and directly teach young children how to **reach in** to develop healthy coping skills and **reach out** to others and opportunities that promote resilience, well-being and optimal development.

Figure 19 Reaching IN . . . Reaching OUT Strategy

First, RIRO is designed to improve teachers' resilience and understanding of their responses to upset and stressed children. Teachers learn how to support and assist each other to maintain positive adult relationships as well as positive relationships with their pupils. Teachers find instructing children affected by traumatic events to be challenging (Alsic, 2012), and this can create further stress and exacerbate a negative feedback loop between child and teacher. A positive-teacher relationship can help the reading achievement of children who come to school from low-income homes with low parent-education levels (McCormick, O'Connor & Horn, 2017). Teachers who can maintain positive-relationships create a positive classroom climate and feel confident and effective, and the children in these teachers' classrooms have better achievement and fewer behaviour problems (Zee & Koomen, 2016). Dr Rianne Bosmann and her colleagues (2018) identified "closeness" and "conflict" as key elements of a positive-relationship:

> *"Closeness can be defined as the degree of warmth and open communication in the relationship, which helps to facilitate children's learning and school performance. Conflict refers to dysfunctional interactions and negativity, which is hypothesized to be related to poor motivation and impaired academic achievement". [page 178]*

RIRO was hypothesised to reduce interpersonal issues between stressed teachers and children with PTS symptoms, who may react to teacher instructions and directions with irritability, defiance, or by not following directions and lack of attention. RIRO helps teacher reduce the use of criticism and negative feedback loops through improving relationships between teacher and child. As children with PTS have difficulty identifying facial expressions of others and/or over-perceive others to be angry or disappointed in them, RIRO also helps teachers adjust their interactions after identifying how children are reacting and feeling. These changes would hypothetically reduce the children's fear and negative perceptions. Finally, the teacher's modelling of positive interactions would also be hypothesised to help children learn positive interaction skills for working with their classmates.

It was hypothesised that the calmer classrooms that resulted from Step One Strategies would provide a foundation for RIRO to be effective. RIRO training was offered before the start of the school year in 2017 to the original strategy schools who implemented the Step One strategies in 2016. Jennifer Pearson, the Director of Training for the RIRO programme f, travelled from Ontario, Canada to New Zealand for this project in late January and early February 2017. Due to resource availability (i.e., cost of professional development), Ms

Pearson developed a separate 6-hour RIRO resiliency promotion workshop for professionals working with 5-12 year old children.

Ms Pearson trained the 73 teachers in day-long training in separate sessions just before the first day of school. The 12-hour RIRO Resiliency Skills Training programme was delivered to the Resource Teachers of Learning and Behaviour who support the study schools. Ms Pearson also provided the 6-hour workshop to other professionals, including psychologists, RTLBs, school principals, community nurses, etc. In the post-training evaluation, more than 90% of attendees rated the training content as very/excellent in terms of its usefulness. Subsequently, replication schools requested RIRO at the start of the replication implementation, beginning from mid-year 2017, due to the positive reports they had heard. Following facilitator training by Ms Pearson, Maureen Allan and Liz McNaughton provided either the 12-hour RIRO training or 6-hour workshop to the replication sites who decided to implement RIRO.

Continuing follow-up support to implement the RIRO strategies was also available to schools. The RIRO follow-up programme in the strategy schools was led by Lee Hooper. The Quality Learning Circle process for professional learning and development concepts (Hooper, 2015) was used in the follow-up programme. Teachers met frequently to discuss RIRO concepts and how to implement them with their pupils. Additional support to both the original schools and the replication schools was provided by Liz McNaughton and Paula Ewing through the RTLB services.

Step Three Strategies

Most study participants frequently used negative, reactive, and withdrawal coping strategies. The use of these coping strategies is associated with low-self-regulation and with emotional maladjustment (Eisenberg, Spinrad & Eggum, 2010).

The Step Three Strategies were designed to help children develop positive skills for coping with the stressors that they experience in their daily lives and the future. Teaching positive coping skills to all children is a population-level (Tier 1) public health strategy that can support other mental health interventions offered by speciality services.

Teaching Positive Coping Skills

Previous research (Liberty, 2017), identified that most study participants frequently used negative, reactive, and withdrawal coping strategies. The use of these coping strategies is

associated with low-self-regulation and emotional maladjustment (Eisenberg, Spinrad & Eggum, 2010). It was hypothesised that by the third study year, children's self-regulation would have improved so that positive coping strategies could be learned. Positive coping strategies that are appropriate for this age group (Compass, 2001) include

- positive cognitive reframing,
- using self-talk to combat negative emotions, or
- using self-talk to generate alternative solutions.

However, study children would struggle with these strategies if they had PTSD symptoms. For example, difficulties with neural connectivity between amygdala and hippocampus and prefrontal cortex would impede the use of language in self-talk to regulate emotions. Sleep problems would make remembering strategies to apply them at the optimal point in time very difficult. Negative cognitions of self would likely interfere with cognitive reframing. Thus, it seemed to be a waste of resources and time to teach positive coping strategies in step one of the strategies in the present project.

Research also indicated that commonly used coping strategies have negative long-term outcomes. These include strategies such as distraction, withdrawal of self, and avoidance. As children tend to use these strategies, and also reactive coping (e.g., yelling, lashing out), not only do they need to learn positive strategies, they must also unlearn these negative coping strategies.

Middle childhood is normally the appropriate time to begin to teach coping strategies, as children are increasingly able to use mental operations to solve problems and to reason. The cognitive strategies and reasoning rules children begin to use result in thinking that is more systematic. In addition, children are developing more complex language and metacognitive strategies (Kail & Barnfield, 2012). Children in this stage are also able to reverse their thinking, but are not able to think abstractly or hypothetically, so they require applied practice and feedback to improve their learning capacity. A child's ability to learn coping strategies will depend on their developmental level, their existing behavioural and cognitive repertoires, the context in which they are learning, and their existing coping styles (Compas, et al., 2001).

Teaching positive coping strategies is appropriate because the focus in New Zealand schools on positive instruction and to improve children's positive learning competencies toward lifelong learning.

Helping Children Develop Hope

Hope is also an essential ingredient to help children and families navigate toward the future. Positive psychology emphasises the importance of hope in improving child and family wellbeing. According to Barnett (2015), hope is comprised of experiences in which they achieve their own goals by marshalling their 'waypower' and their willpower. Goal setting helps children learn to set their own directions and gives them a future orientation, rather than living in the moment or dwelling on the past. 'Waypower' is developed by learning how to solve problems (i.e., find a pathway) to achieve their goal. Willpower is developed by learning that their own actions can produce changes in their own life, which is where self-directed motivation comes from (Granlund, Wilder & Almqvist, 2013; Marques, Lopez, Rose, & Robinson, 2014).

Teaching children goal setting and problem solving, and how to monitor their own progress is associated with improving their mental health and their behaviour in typical children (Marques, Lopez, Rose & Robinson, 2014), and in children who have experienced disasters and trauma (Granlund, Wilder & Almqvist, 2013; Kwok, Gu & Kit, 2016; Le Brocque, et al., 2017; Modecki, Zimmer-Gembeck & Guerra, 2017; Shiota, 2006; Thomassin, Marion, Venasee & Shaffer, 2017; Vernberg, Hambrick, Cho & Hendrickson, 2016; Wehmeyer & Shogren, 2017).

Inquiry-led Learning Then Self-Determination Goal-Setting Model

The combination of an inquiry-led learning and then self-determined goal setting is an approach that will help children learn informed goal-setting, problem-solving, and 'way power." It is based upon Self-Determination Theory (Deci & Ryan, 2000; Granlund, Wilder, & Almqvist, 2013), which emphasises the importance of children developing autonomy, competence and relatedness, which are also core aspects of resilience (El-Khodary & Samara, 2019 However, development of autonomy, competence and relatedness requires practice. Children need teacher-facilitated experiences to gain skills in executive functions associated with the highest form of self-regulation by learning how to set goals to change their own behaviour.

> Learning to understand how events affect you, and to then set goals to change those things that are problems is an educational approach to teaching positive coping skills. This involves:
>
> - finding out information that is meaningful to you with the guidance of a supportive educator. (The teacher is a 'guide on the side', not a 'sage on the stage', as Howard Gardner writes.)

- using positive goal setting as a form of positive self-talk to combat negative emotions and cognitions,
- using pathways-thinking to generate alternative solutions and
- using self-monitoring to determine if goals are being met, or additional problem-solving is needed.

Learning to understand and change yourself can reframe your thoughts about your own competence and give you hope for a better future. ("cognitive reframing")

-

In one model of inquiry education, children are given guidelines about content to explore. Children are expected to learn and explore all of the indicated content, but can choose to go in-depth in specific topic areas.

Often inquiry education involves small groups of children working together. Children collaborate to develop topics, and contribute and share their own learning within the group. This is contrasted with the lecture-model of learning, in which children are told information and expected to learn it. Howard Gardner, Professor of Education at Harvard Univeristy, contrasted the models as "Sage on the Stage vs. Guide on the Side"(2011).

Inquiry-guided instruction would be applied to children's wellbeing, the curriculum area would be one related to child health and wellbeing, such as sleep, healthy eating, screens and so forth. Children would be able to discover facts related to the topic through teacher-facilitated research. Once the topic was researched, children would be able to determine how that information might be applied. For example, to set a goal to improve their own wellbeing by applying what they have learned in the inquiry section. Through this process, children will become more independent learners, and begin taking responsibility for their learning as they acquire the skills, understanding and skills to apply their learning to improve their own lives (Barker & Munakata, 2015; Eisenberg, Spinrad, & Eggum, 2010).

The self-directed goal-setting model provides a framework for a teacher to help children develop the skills needed for self-direction by allowing them to set their own goals, develop pathways to achieve those goals, and evaluate their own progress, and solve problems that block their goal achievement.

The principle programmes identified for the project were in sleep education and positive coping, which were to be implemented once classrooms were calm.

Yes, I Can! Sleep Inquiry & Sleep Scientist

The Yes I Can! Seep Inquiry and Sleep Scientist programmes were developed, trialled and implemented for the project (B. Liberty, 2018a).

First, the recommended sleep duration of children was identified. The New Zealand Ministry of Health uses the Sleep Health Foundation's research-based guidelines for recommended hours of sleep, and the recommendation for children of primary school age is within the range of 9-11 hours (Sleep Health Foundation, 2019). Research indicated that as little as an increase of seven minutes per night could improve daily behaviour. Interventions that involve both schools and homes are more likely to produce improvements in sleep duration (Busch, Altenburg, Harmsen & Chinapaw, 2017).

A literature review identified that a single session sleep education programme of 1.5 hours using self-determination for goal-setting was shown to successfully improve knowledge about sleep in 6th graders (Vollmer, Hammer, Keller, Maxand, Díaz Morales, & Randler, 2014). A sleep education programme, "Sleep for Success", that involved parents and teachers, as well as 45 children aged 7-11 years improve sleep duration by 7 minutes and also showed positive effects on children's academic skills, however, this study excluded children with "psychiatric" problems (Gruber et al., 2016). This involved 6 two-hour sessions over 6 weeks. It used teacher-directed experiential learning which has some overlap with self-directed goal development, in that it seeks to have the knowledge gained applied to the 'real world". However, the programme did not have evidence that it helped children who had experienced trauma, or with the majority of children experiencing sleep problems. Therefore, it appeared that this programme would not be suitable in the study schools.

Further review of the literature did not identify any evidence-based sleep programmes to implement for the children's age group and characteristics that would fit within the NZ health curriculum. Therefore, a new sleep education programme was commissioned for the intervention.

Learning how to improve sleep is learning a positive coping strategy because sleep problems are one of the most frequent consequences of stress and a key symptom of PTSD. Learning how stress impacts sleep and how to improve sleep problems gives children a tool to use in the future when their sleep is disrupted by stress.

There were two phases of the sleep education programme: Inquiry and Self-Determined Goal-Setting. The *Yes, I Can! Sleep Education programme* (B. Liberty, 2018), which was designed for the study, consisted of the following components:

- a draft notice for the school's parent newsletter
- two workbooks for children,
- a curriculum guide for teachers,
- instructional materials which parents could use,
- information for parents,
- a website for teachers, (https://bromtreeinquiry.com/)
- a Facebook group for parents.

The implementation of the programme was suggested to be three to five weeks for the inquiry, and then three weeks for the Sleep Scientist programme, so that the entire programme could be completed within one school term. Each session was planned to be around 30 minutes in length.

Phase 1: Sleep Inquiry (Education)

During the inquiry phase, children learned about sleep. Knowledge is required for children to be able to set goals, problem solve, and improve their sleep. Children worked independently, in groups and/or under teacher direction, and had a workbook to guide them in their inquiry (Figure 21). The workbook featured "Moe" (a Māori word for sleep,) who guided the children throughout the project. Children also made Moe soft toys, as well as coloured Moe to their liking.)

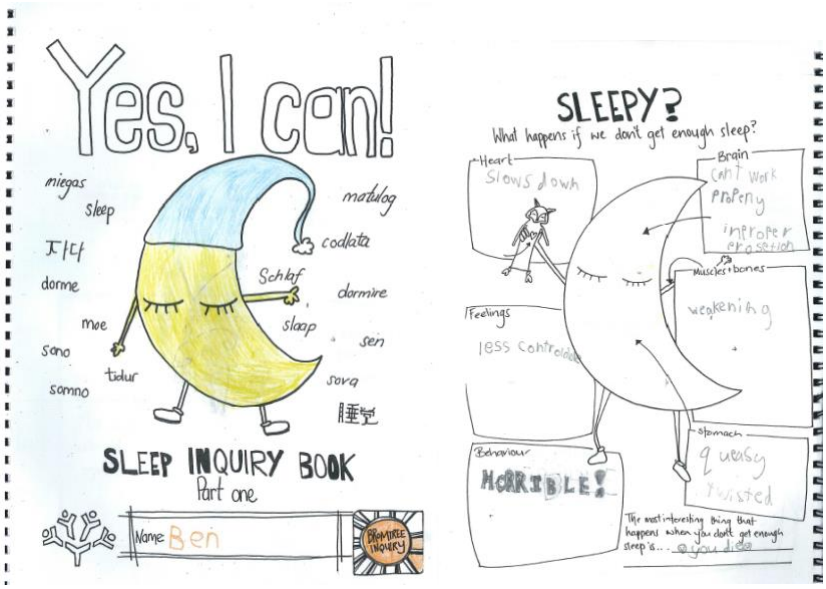

Figure 20 Yes, I Can! Sleep Inquiry book sample pages (B. Liberty, 2018).

The topics in the inquiry workbook included human and animal sleep, sleep around the world (which included stories of children who shared bedrooms, or had no fixed place to sleep, or slept outside; https://youtu.be/AIgFKeSgT-4), the sleep wake cycle, how the room around us affects our sleep, the recommended hours of sleep and how sufficient sleep and poor sleep affect behaviour and the body. Children worked on each topic during the work sessions, with guidance, resources, and access to websites as planned and facilitated by the teacher. They were also able to choose what topic interested them most, and to explore that in depth. (The evaluation, covered in Chapter 5, showed that children did choose to spend a great deal of time in the inquiry, and were sometimes reluctant to go onto the next topic in the school day!)

Children were not to be required to write in the workbooks, because if they had learning problems, this would cause unnecessary stress.

Phase 2: Self-Determination Goal Setting and Problem Solving

The second workbook, *Yes, I Can! Sleep Scientist*, was used for exploring the child's self-determined study of their sleep, goal-setting, and problem solving (Figure 22).[5] This involved children learning about how scientists study sleep. Children were encouraged to use "sleep slips" to collect scientific information about their own sleep, to diagram the place where they slept, and to describe their bed-time routine during the first week of this phase.

Next, after looking at their scientific results, children reflected on their own sleep and related it to what they had learned during the inquiry. After this, children were encouraged to come up with a goal to improve their sleep (they did not have to write this down or announce it, as it could be a private goal). For example, during the pilot study, one child came up with a goal to go to bed at 7.30 (so he could get more sleep so his muscles would grow so he could run faster at the end of the year cross-country).

Next children identified or drew three different pathways to their goal, talked about "path blocks" (imagine boulders in their way) that could get in their way. For example, one 'pathblock' to going to bed at 7.30 was that the family was in a rental home while their home was being repaired, and the child shared a room with an older sibling who liked to lie in bed and look at social media), and problem-solved ways around the blocks (e.g., getting the older sibling to look at social media in another part of the house). Then the children picked one pathway to start on toward achieving their goal.

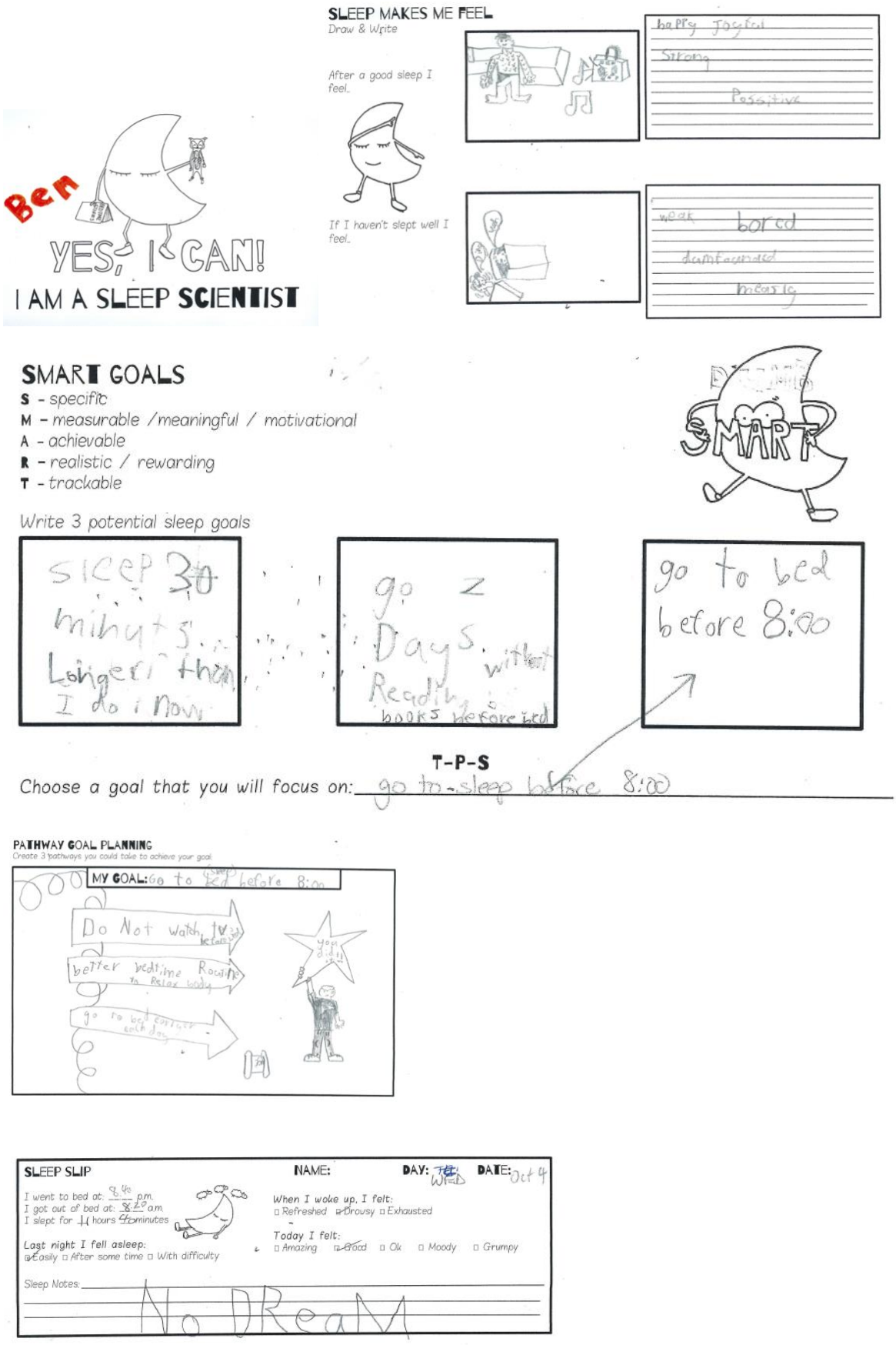

Figure 21 Pages from the *Yes, I Can! Sleep Scientist* workbooks (B. Liberty, 2018).

The process of collecting information on their sleep was repeated for one week. At the end of the week, the children reflected on whether they had achieved their goal. If not, they looked at their alternative pathways, and could choose to work again toward their goal, or modify their goal. This was the self-directed problem-solving component of the process.

Therefore, within the programme the children learned about sleep and how stress can affect their sleep, and about how they can have the power to improve their own sleep. Since sleep problems are a common and serious aspect of stress, learning how to cope with sleep problems is a key component of resilience.

Implementation

Originally, the Sleep Education programme was to be implemented in Term 3 and 4 of the second project year. However, the implementation of this programme was delayed because a suitable programme was not able to be identified, and a new programme needed to be written. The *Yes, I Can! Sleep Education* programme was trialled in terms 3 and 4 of the second project year with a small group of non-study children. The trial resulted in some minor modifications. The most-important modification was to try to address parent changing a sleep goal when the child brought it home, and information to parents was adjusted about this. In addition, a parent Facebook page and a provision to provide access to a clinical psychologist were added to the resources (but no parent ever chose to access the psychologist's support).

Teachers in the original strategy schools attended professional development that covered the impact of sleep problems on children's school behaviour and learning, the effects of PTS on sleep, the characteristics of study children's sleep, and the implementation of The *Yes, I Can! Sleep Education* programme (about 2-3 hours of professional development).

The *Yes, I Can! Sleep Education programme* was implemented in all of the original study schools during the third project year for children from year 4-year 8. One school also developed a teacher-led version based on discussion for years 1-3.

From the project point of view, the goals of the sleep education programme proposed for the intervention in the present study were to reduce children's PTS symptoms through improving their sleep. A separate study examined children's sleep, facial recognition and memory in a sub-set of children who participated in the programme.

Other Positive Coping Programmes

Other positive coping programmes were piloted in the final project year (Additional details of these programmes are provided in Appendix 2). These were not able to be implemented in all of the original strategy schools due to resourcing issues.

Yes, I Can! Sparkle Under Pressure (B. Liberty, 2018c).

"Sparkle" is a universal positive coping programme for children aged 9-13. It is designed to be delivered in small groups (but to all children in the classroom) by a trained facilitator. It used a combination of facilitator-directed and self-directed inquiry about stress and coping that helps children learn to recognise how their body responds to stress, and how stress can impact their health and relationships. It explores how other people can show signs of stress and the different ways the people cope with stress, including toxic coping (e.g., aggression, substance-abuse), negative coping (e.g., distraction, avoidance) and positive coping (e.g., seeing alternative perspectives). In the second part of the programme, children set goals, explore strategies to calm down and problem-solve ways to reduce their stress and to recognise and help others who are stressed. This programme addresses autonomy by using self-directed goals, competence, by teaching self-evaluation toward goal achievement and relatedness, by learning how to help others who are stressed.

During the third project year, this programme was piloted in one strategy school for about half of the year 5 and 6 pupils, and in one replication school for the year 8 pupils.

Nature Videos for Self-Directed Coping (Department of Conservation).

Helen Gillespie and Sarah Newcombe, both from the Department of Conservation—Te Papa Atawhai – coordinated the development of the videos used in this programme. The literature review was a collaboration with Clare Vesty (2017).

Van der Kolk (2006) argued that traditional approaches to the treatment of posttraumatic stress symptoms do not pay sufficient attention to the brain centres responsible for the storage of emotions related to trauma, nor the neural pathways that regulate physical and emotional hyperarousal. Roger Ulrich and colleagues (1991) reported that viewing nature photographs and videos reduced aggression and negative thoughts and increased calm and positive emotions. More recently, viewing nature videos with music sound-tracks have been shown to significantly reduce induced stress and arousal in adults in comparison with other videos and/or

sounds (e.g., urban landscapes) (Alvarsson, Wiens &Nilsson, 2010; Largo-Wight, O'Hara & Che, 2016). Similar stress-reducing benefits have also been found in studies that involved walking in real natural gardens or forest or park environments. Similar videos also help people in hospital wards and doctors' waiting rooms feel calmer (reduce situational stress).

However, young children can't leave the school grounds to go to the park or take a walk on the beach by themselves, so viewing nature videos is an alternative that could be acceptable to schools. A pilot study (Vesty, 2017) showed that watching nature videos on a tablet was acceptable to teachers and children in local schools. Results of this study suggested children preferred to self-identify when they were upset, and would choose to watch a video to calm themselves.

Previous research used overseas nature and short videos, while research indicated that more relatable content (e.g., New Zealand flora and fauna, not African or USA flora and fauna) and a longer duration would improve impacts. The Department of Conservation provided two edited videos of about 20 minutes each– one featuring underwater shots of dolphins, and one featuring Snares penguins on a rocky shore.

In the pilot, the child determined when to use the video to calm themselves down, which was available on a tablet that did not have any games, internet connections, or other software.

Yes, I Can! Be Kind (B. Liberty, 2018b)

This programme was developed as requested by one school, who wanted a type of inquiry-based progamme for children in the lower grades that would be able to be implemented whilst the older years were involved in the sleep programme. It explores being kind "to the environment, to myself and to other people". This programme is aimed at younger children – for whom the Sleep Inquiry and Sleep Scientist programmes are not suited--as an introduction to positive coping and self-regulation, and is about 20 minutes a day. There's no teacher training required and very little preparation to deliver it. It is based on current leading research and is suitable to be delivered by the classroom teacher to the whole class.
Children learn about kindness to the environment, animal, others and themselves, develop their own goals to be kind, and practice kindness. For more information about these programmes and their impact, please see Appendices 2 and 3.

Strategy Implementation

A key issue in the implementation of strategies has been their acceptability in 'real-world' situations, as the overwhelming majority of published research studies are in situations highly-controlled by experimenters. One of the strengths of the current study is that the schools controlled the implementation by determining the acceptability of the strategies. In the replication study, implementation was determined by the school, preschool and kindergarten communities under the leadership of the principal or manager. Resourcing from the Primary Principals Association, the Rata Foundation, and the Te Paeroa RTLB Cluster was made available in the original schools through donations to cover the costs associated with implementation. Professional support and resourcing from Te Paeroa RTLB Cluster made the replication possible.

In the original strategy schools, Step One strategies were introduced into three of the four schools in 2016. Step Two strategies were introduced in the first three schools in 2017, and Step Three strategies in 2018. The fourth school began implementation of the Omega three strategy in Term 2, 2016, and the majority of other Step One strategies in 2017. RIRO (Step Two) and Sleep Education (Step Three) were both implemented in 2018.

The Replication Schools began implementing Step One and Step Two strategies during 2017-2018, as the results of the Step One strategies demonstrated effects within 2-3 school terms. One replication school implemented Sleep Education after 4 terms, and one school implemented the "Sparkle" positive coping group after four terms.

Overall, the replication study included those organisations which had originally agreed to implement strategies, but which did not implement any strategies during the study period [21% of study children were in schools or kindergartens with 0% strategy implementation]. Implementation in schools and kindergartens ranged from 11% to 78%. Strategies which were least likely to be implemented included changing the wall colours of classrooms—only implemented in schools completing rebuilds or in new builds, noise reduction strategies, specific strategies for teacher wellbeing, and supporting parents through the provision of omega 3 supplements.

CHAPTER 6. RESULTS

Reduction in Percent of Children with Clinical PTS Symptoms

The results show a significant reduction in children with clinical-levels of PTS in the initial strategy schools and the replication schools (results for individual schools are shown in Appendix 4). Schools which did not implement the strategies showed an increase over the same period.

Original Strategy Schools (Study 3)

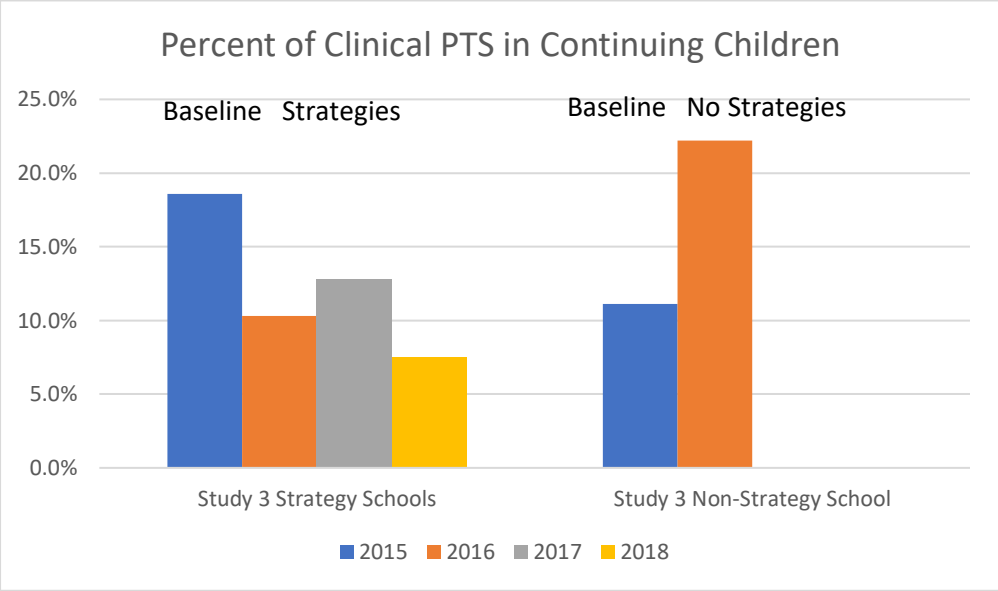

Figure 22 Effects of strategies on reducing PTS symptoms in children with clinical-PTS in Study 3.

(Same children measured at each time point.)

The results show that the proportion of children with baseline clinical-level Post-traumatic Stress has reduced from 18.6% at baseline in the initial strategy schools to 7.5% after three years, but has about doubled in the high-decile contrast school (Study 3; Figure 22). This is both practically significant, in that the proportion of children with high stress has been more than halved during strategy implementation, and statistically significant (Chi-square = 8.996, df=1, p>.003). The mean PTS score of continuing children with clinical PTS at baseline has significantly (p<.001) reduced from 7.73, above the clinical cut-off, to 4.54, below the cut-off.

Replication Schools, Preschools and Kindergartens (Study 4)

At baseline in the replication study, there were 31.8% of children in the total sample with clinical-level PTS symptoms. This ranged from 15.2% to 35% across schools, and there were no significant differences between the primary schools which replicated the strategies and the contrast schools in the replication group in the average baseline PTS score. In kindergartens, there were 15.6% with clinical PTS at baseline, ranging from 0% in two kindergartens to 35%.

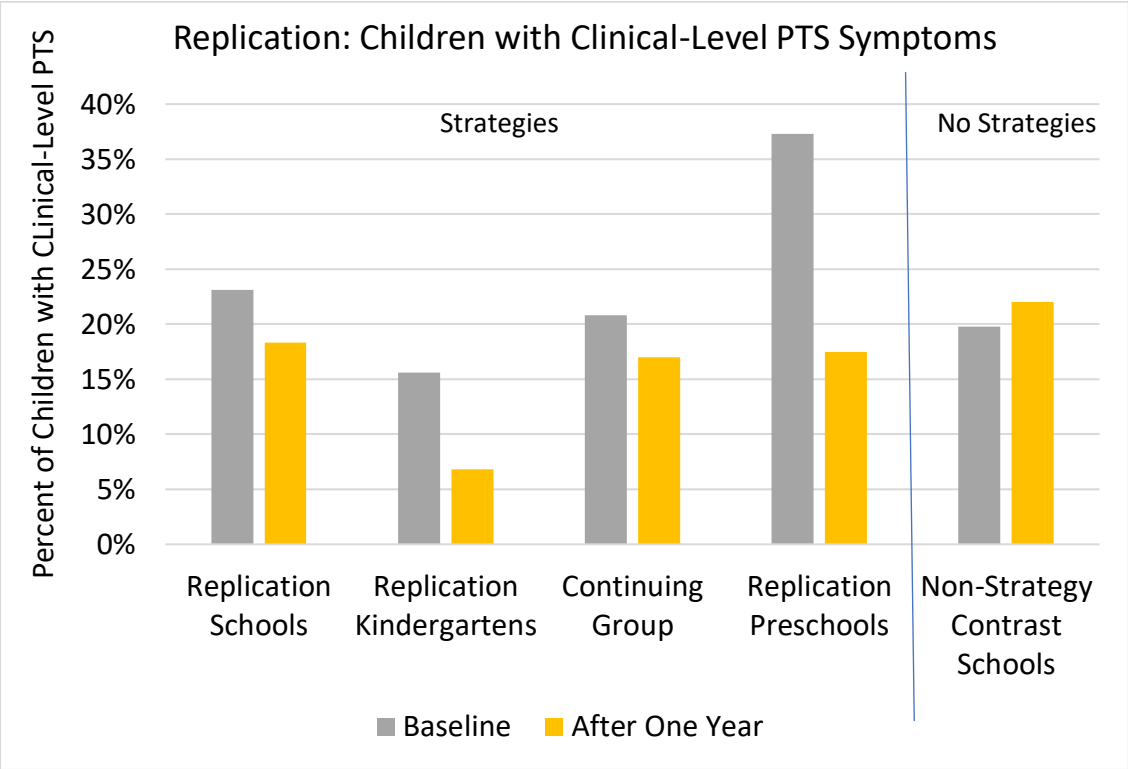

Figure 23 Effects of strategies on reducing PTS symptoms in children with clinical-PTS in Replication Study 4.

After implementing strategies, the per cent of children with clinical PTS in the eight replication schools decreased to 18.8% (Figure 24). The per cent of children with clinical PTS in the six kindergartens decreased from 15.6% to 6.8%, while the children with low resilience in preschools decreased from 37.3 % to 17.5% (Figure 24). The proportion of children with clinical PTS symptoms did not improve in the contrast schools (Figure 23).

In addition, the mean score of continuing children school and kindergarten children with PTS at baseline reduced significantly ($p<.001$) from 7.82 (SD=1.4) to 4.88 (SD=3.26). In preschools, the continuing clinical children's low resilience score used to identify clinical

children significantly (p>.001) improved from 2.30 to 3.68 while the per cent of children with low resilience decreased (Figure 24).

Overall Improvement

At the end of the baseline in Study 3, 37.7% of the children attending the strategy schools in Study 3 had zero PTS symptoms. After one year of strategies, this increased to 44.9%. After three years of strategies, 48.4% had scores of zero, which is a significant (p=.035) improvement (Chi-square=4.454, df=1, p=.035 excluding children with new clinical PTS (see following section for a discussion of these children).

In the replication group, Study 4, 31.4% had zero PTS symptoms at baseline and, after one year, this had increased to 37.6%, which is also a significant improvement (Chi-square=6.818, df=1, p=.0009).

Gender, Priority Ethnicity, And ILE

Gender. In the original strategies group, boys were slightly more likely to improve than girls (39.5% v. 32.6%) but in the replication group, there was no significant difference in the improvement by gender (42% of girls, and 41% of boys improved).

Priority Ethnicity. At baseline in Study 3, there were no significant differences in the mean PTS score within the clinical group according to priority ethnicity, but differences were exacerbated over time, and were significantly different by the end of 2017 (t= -2.160, p= .039), with the mean scores for children of priority ethnicity showing *significantly greater improvement* than the mean score of children of other ethnicities (Figure 24). Within the group of children who had high PTS scores at baseline, there were no significant differences by ethnicity in the percentage of children who improved from baseline or continued with high PTS.

In the original strategies group, children of priority ethnicity were more likely to improve (48.3 v. 33.6%), but these differences were not significant. However, children of priority ethnicity in the clinical group showed more improvement than children of other ethnicities (Figure 25).

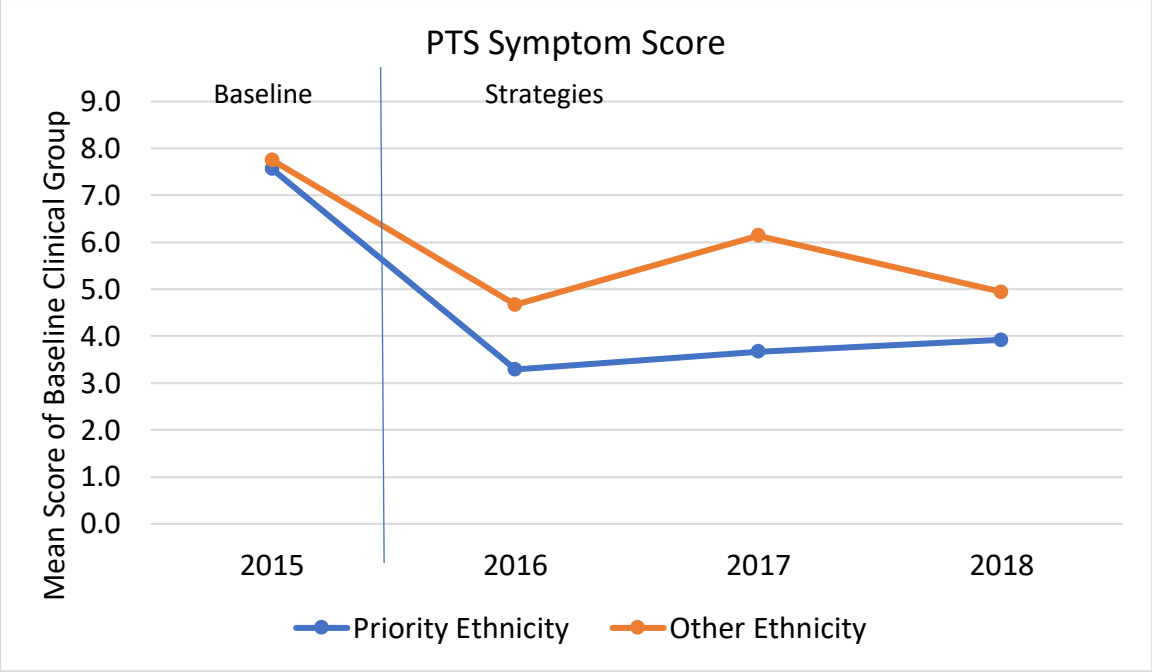

Figure 24 Effects of strategies on PTS Scores in the clinical group by priority ethnicity (Study 3).

Neighbourhood SES. Children from high SES neighbourhoods were significantly (p=.044) more likely (42.5%) to improve as compared to children from mid (31.8%) and low (35.1%) neighbourhoods in Study 3, however, this is complicated by the fact that children from the mid and low decile neighbourhoods were more likely to attend a school that suffered a significant traumatic event in 2018. Information on neighbourhood SES in the replication group was not available, but a similar form of analysis can be reported using school deciles as a rough measure of family SES.

Clinical vs. Non-Clinical Groups. Children in the Study 3 clinical group (63.3%) were significantly more likely to improve than children in the non-clinical group (30.5%; Chi-square = 12.118, df =2, p=.002). However, children in the non-clinical group included children with scores of zero at both time points; scores of zero cannot improve!

Innovative Learning Environments. Children in ILE were more likely to improve (as compared to stay the same or worsen) their PTS scores (50.3%) as compared to children in traditional classrooms (22.3%)(Study 3). However, confounding this, children in ILE were more likely to have participated in two important strategies (i.e. have water bottles for the drink to think programme and participate in the Yes, I Can! Sleep Education programme; (Improve PTS:

Chi-square=15.917, p>.000; Water bottles: Chi-square=22.170, p>.000; Sleep education: Chisquare=10.049, p=.002).

School Decile

The improvement in overall PTS symptoms across all children is shown across school deciles in the strategy replication schools (Figure 25) (i.e., 52% of children from low decile schools, 38% from mid-decile schools and 41% from high decile schools had lower PTS scores). There was no significant difference across deciles (Chi-Square=4.956, df=4, p=.292).

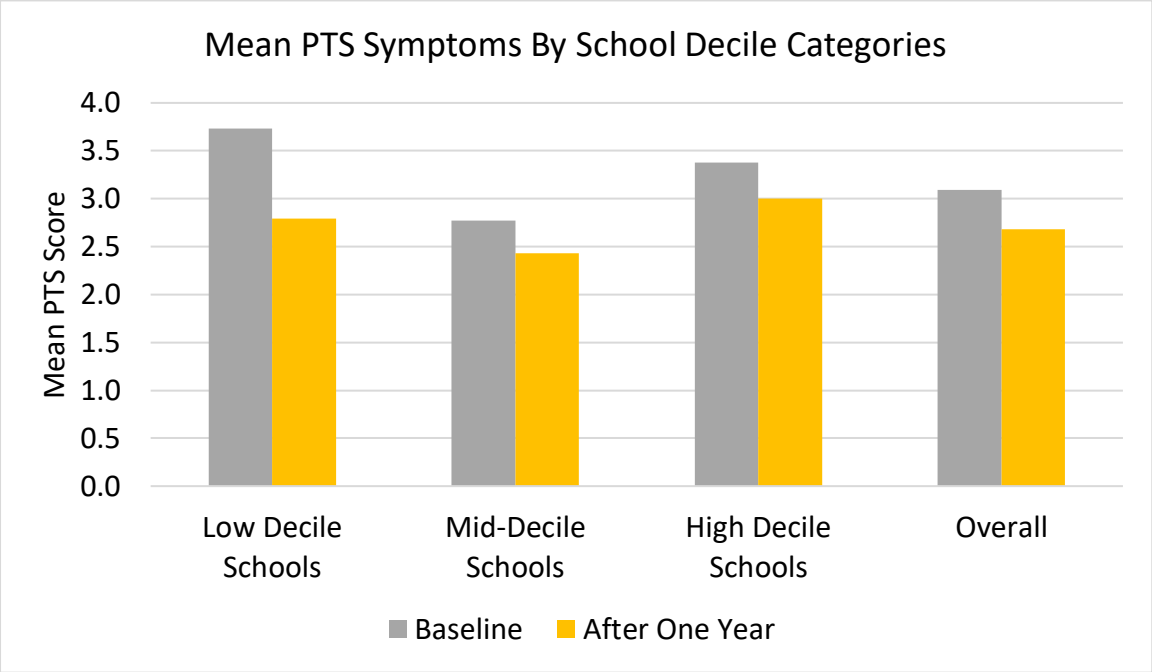

Figure 25 Strategy effects after one year on PTS symptoms by school deciles in Study 4.

Differences by Age

Similarly, in the replication study, children with baseline clinical-levels of all ages reduced the average number of symptoms, and there were no significant differences by age at the final measure for the same children measured at each time point (Figure 26).

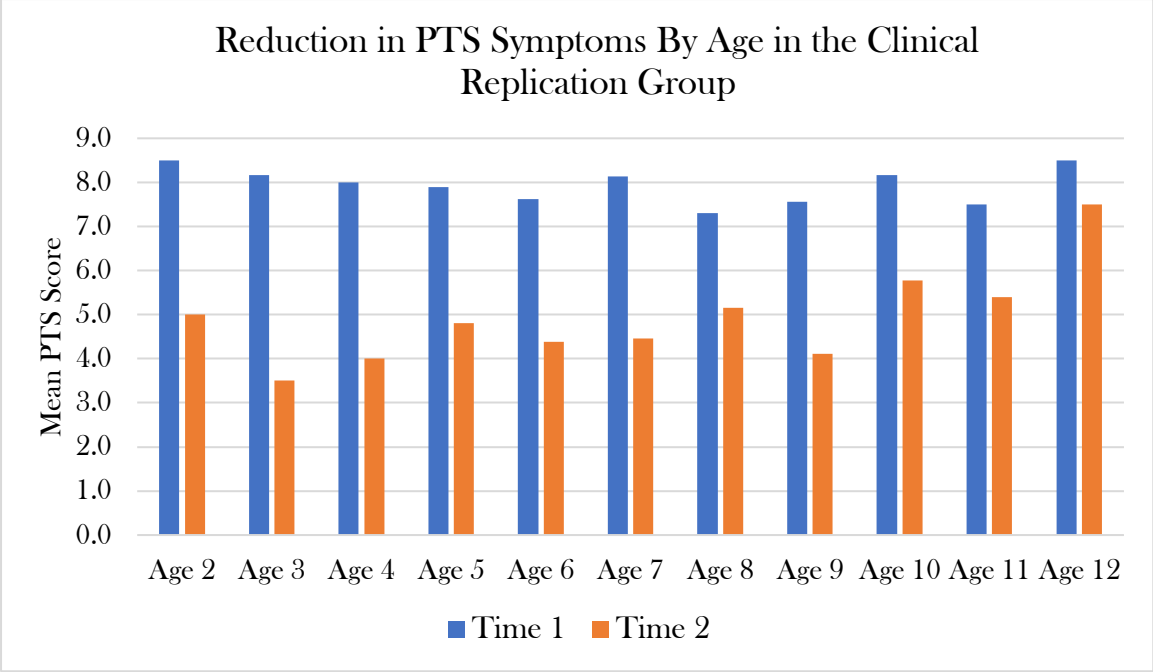

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Figure 26 Effects of strategies on PTS symptom scores by age

Behaviour Problems and Persistence

The results in the original study schools indicate that the differences between those clinical-level children who improved and those who did not improve are not primarily related to characteristics such as gender, school decile, or year in school because there were no significant differences in their baseline PTS score. The differences in the results may be related to the number of strategies implemented, as discussed in the next chapter, or there might be some difference in the number, intensity or type of behaviour problems expressed as PTS symptoms.

However, 20% of children in the group that improved were rated as persistent at baseline as compared to 0% of the group that that did not improve. At the end of the project, 0% of the improved group and 50% of the continued clinical group gave up easily (p=.001), which supports the identification of persistence as a key characteristic of those who improved. However, analyses of the differences require further exploration.

DSM-5 Symptom Change

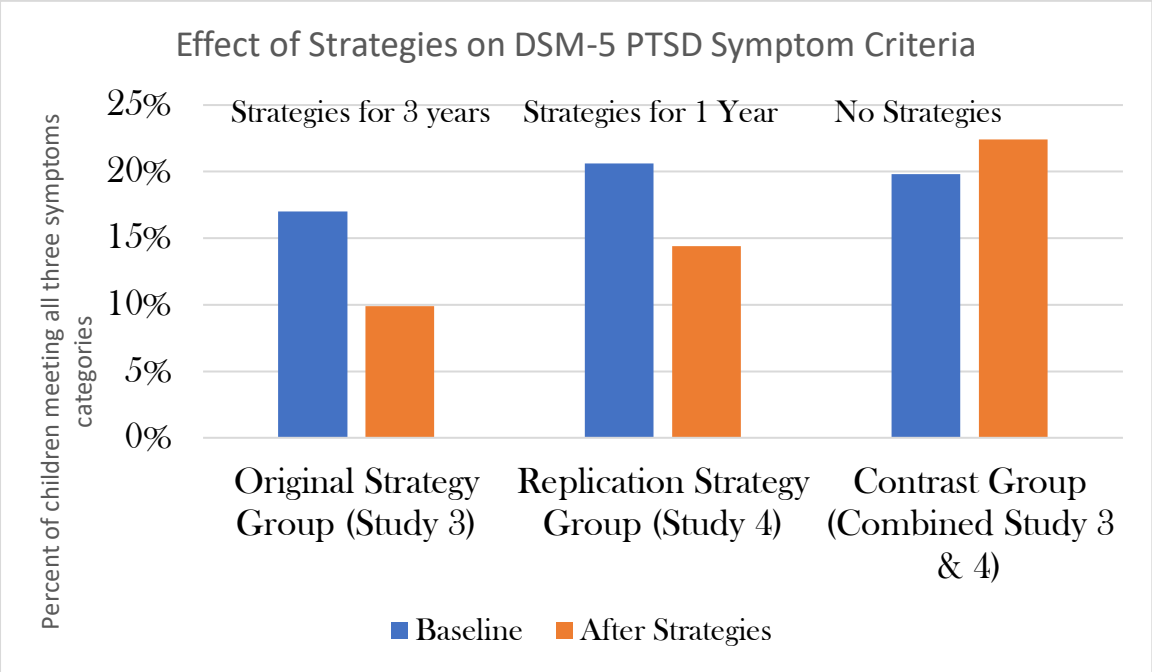


Figure 27 Effect of strategies on percentage of children meeting three DSM-5 Child PTSD diagnostic symptom categories.

This analysis provides a supplementary picture of the strategy effects across all children. There was a significant increase in children who met zero of the DSM-5 PTSD symptom criteria in the original strategy group, from 40% to 56% (p=.002), a borderline improvement (p=.059) in the replication group, from 40% to 45.3% and no significant change in the contrast group (p=.36).

There were reductions in children meeting all three of the symptom categories, with a greater reduction in the original strategy schools after 3 years as compared to the replication schools after one year. On average, the children in the contrast schools had increased symptoms by DSM-5 categories without strategy implementation (Figure 27).

New Clinical Cases

In addition to the 7.5% of children with continuing clinical-level symptoms in the original schools, a small group of study children who had sub-clinical-level symptoms at baseline increased to the clinical range over three years. All but two of these children were at two schools and most were boys in traditional classrooms. Both of these schools suffered

significant traumatising events in their school community that involved boys. In each school, children who were affected had previous exposure to traumatising events in addition to the earthquakes. Similar rates of new clinical cases were not evident in the other original schools or in the replication study group. Therefore, these few children are not included in the overall analysis.

The Adverse Childhood Experiences studies, as discussed in Chapter 1, have determined that the accumulation of four or more (some studies say three or more) adverse experiences before the age of 18 is predictive of developing physical and mental health problems in adulthood. Children begin to display PTS symptoms in response to the number of traumatic events they have experienced, although this may be affected or moderated by the support they receive and the development of adaptive coping skills. Therefore, the most likely explanation for children with new clinical-levels of PTS is that the additional traumatic events they experienced in their school community, and which affected their teachers as well, exceeded their ability to cope. It is hoped that retention of the strategies during subsequent years will assist these children to regain their regulation.

These new cases of children expressing clinical-level PTS symptoms highlight the vulnerability of children to the experience of new adverse events. It appears that the sleep education programme was not sufficient to help these children maintain their initially low symptom levels. Additionally, these children did not have access to the Yes, I Can! Sparkle positive coping programme. The troubling issues about these new cases are discussed further at the end of this report.

Improvements in Self-Regulation

It is often believed that children who do not exhibit self-regulatory behaviour at school are "naughty" or are 'choosing' to behave badly or are "making poor decisions." However, recent research has demonstrated that post-traumatic stress negatively affects the parts of the brain that are required for self-regulation and positive decision-making, and thus these behaviours can be symptomatic of PTSD. Children with PTS symptoms have a brain with high arousal that simply does not respond to regulatory attempts from the prefrontal cortex, and so poor self-regulation is often identified as a characteristic of children with PTSD.

It was hypothesised that as children attended calmer classrooms, and their PTS symptoms, if any, reduced, their positive characteristics would emerge or have the opportunity to develop.

Items from the Positive Behaviour Checklist as reported by teachers at the baseline were compared with reports at the end of the project to evaluate this hypothesis. Teachers were experimentally "blind" to children's previous reports, and to which items related to PTS symptoms throughout the study.

On the other hand, the development of self-regulation is a positive protective factor that buffers against the impacts of subsequent adverse events and stress (Hamby, Grych & Banyard, 2018). The development of self-regulation has also been seen as a component of post-traumatic growth.

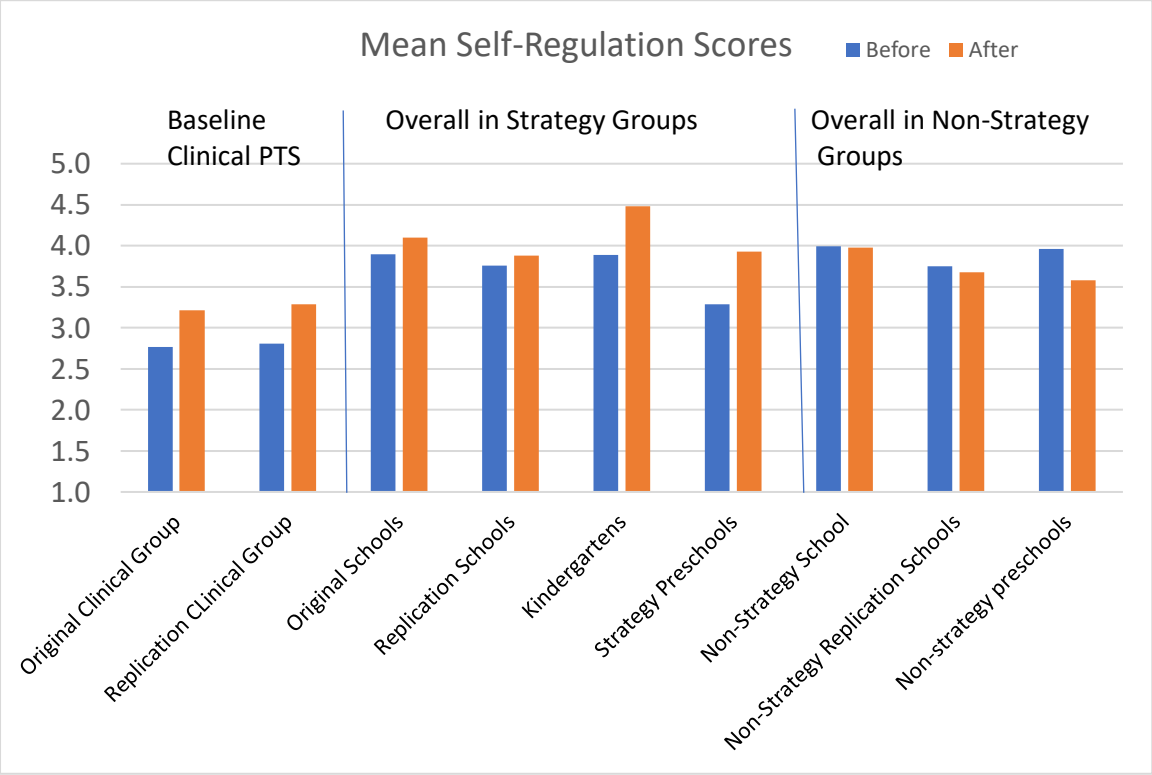


Figure 28 Effects of strategies on self-regulation (Study 3 and Study 4).

Improvements in the mean self-regulation across the study groups (Figure 28) show that all strategy groups showed significant improvements in mean self-regulation scores (i.e., in the original clinical group, p=.006; clinical replication group, p=.001; strategy replication schools, p=.015; kindergartens, p=.001; preschools, p=.005) as contrasted with reduced average self-regulation in the non-strategy schools and preschools.

School Decile

There were no significant differences in self-regulation by school decile. Although children in the contrast schools improved, this improvement was smaller than in the strategy schools (Figure 29).

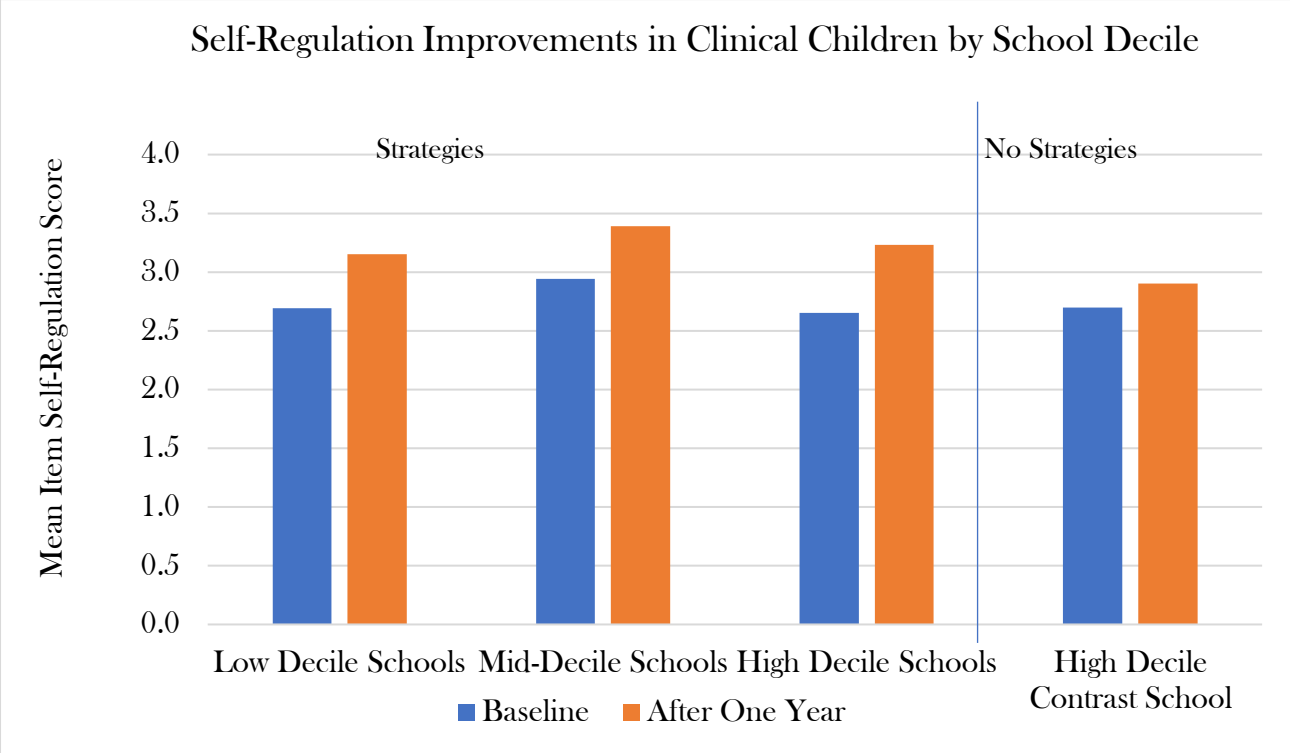


Figure 29 Effects of strategies on self-regulation by school deciles.

Replication Groups -same children at each time point

Priority Ethnicity, Gender and Neighbourhood SES

Children in the clinical PTS group from the original strategy schools at baseline made significant improvements in self-regulation (p=.017) across the project years. Figure 30 shows that children with priority ethnicity in Study 3 had a slightly higher rate of self-regulation in the clinical group at baseline, and also improved at a slightly higher rate during the strategies, as compared to the clinical PTS children who were not priority ethnicity.

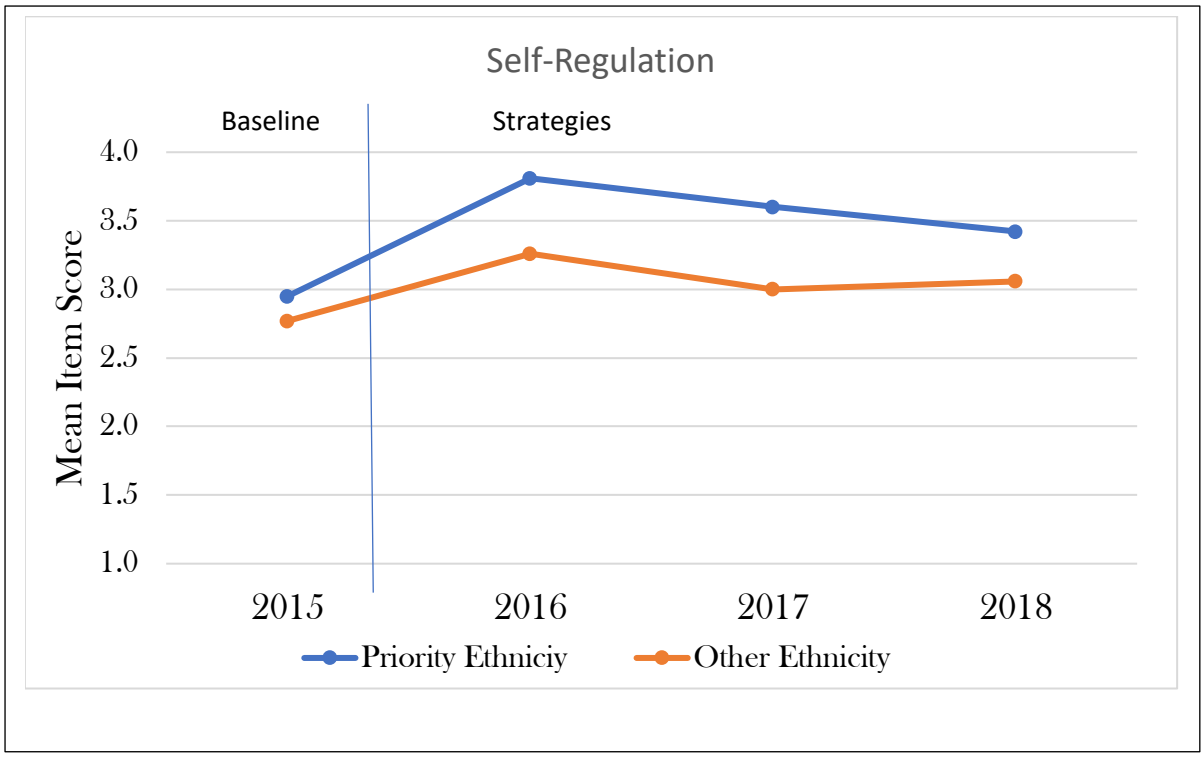


Figure 30 Effects of strategies on self-regulation of clinical PTS group, by priority ethnicity

In the overall group, paired t-tests showed that girls (p=.008) and children of priority ethnicity (p=.036) made the most statistically significant changes. When analysed by neighbourhood SES in the original group, neither children in low, mid or high decile neighbourhoods made statistically significant improvements, indicating that was not a factor affecting change in self-regulation.

Improvements in Learning

Changes in learning were assessed by three different factors: rates of children meeting curriculum standards, attitude to learning and teacher expectations for learning.

Meeting Curriculum Standards

In the original strategy schools, after three years of strategies, children with clinical-levels of PTS symptoms improved their reading, writing and maths assessments across the first two strategy years (Figure 31). Reading continued to improve during the 2018 assessments, however, writing and maths were somewhat lower. This may reflect the change from national standards to school-determined criteria (Chapter 2).

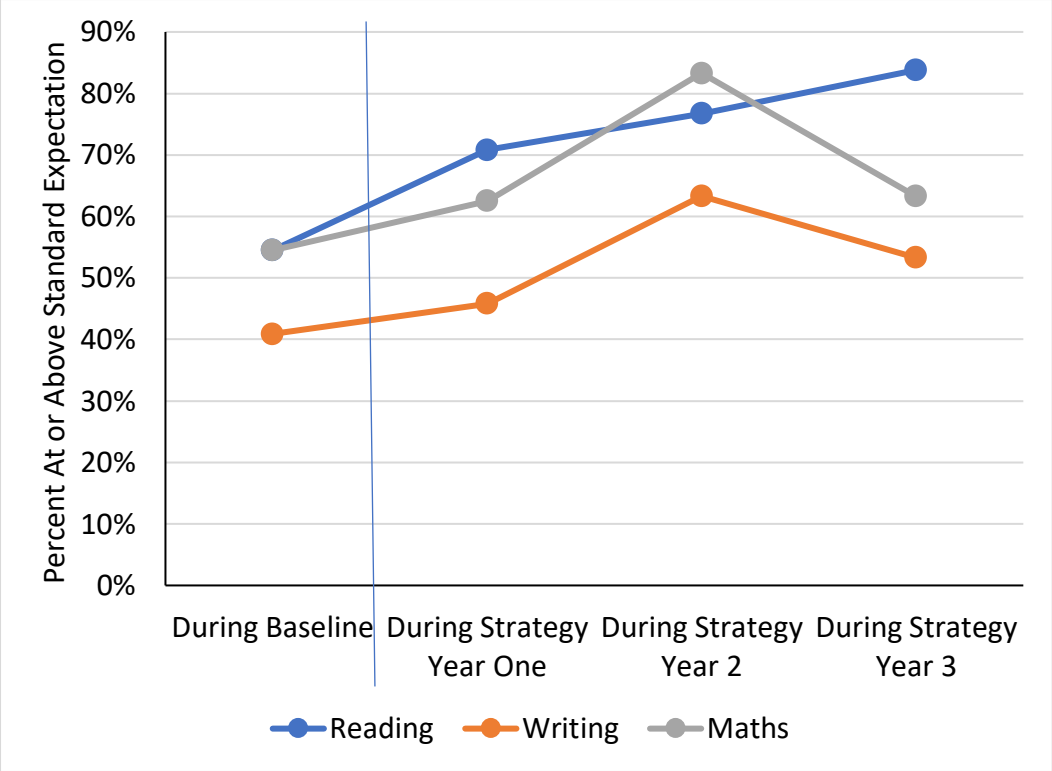


Figure 31 Effects of strategies on the reading, writing and math of children with clinical PTS over three years in the original study schools.

Gender, Priority Ethnicity, and Neighbourhood SES

Compared with the baseline, a larger proportion of children identified as priority ethnicity made gains in meeting standards for reading and writing at the end of the project as compared to the group of children with other ethnicities (Figure 32). There was no significant difference in maths. It is not surprising that the most gains were made in reading and writing for this group, which had higher PTS symptom scores at baseline. This is because neurobiological research has indicated that language-related functions are likely to be impaired in PTSD (Cook et al., 2017). As PTSD symptoms reduce, language functioning should improve. In addition, as described above, children's self-regulation improved, as well as teacher expectations.

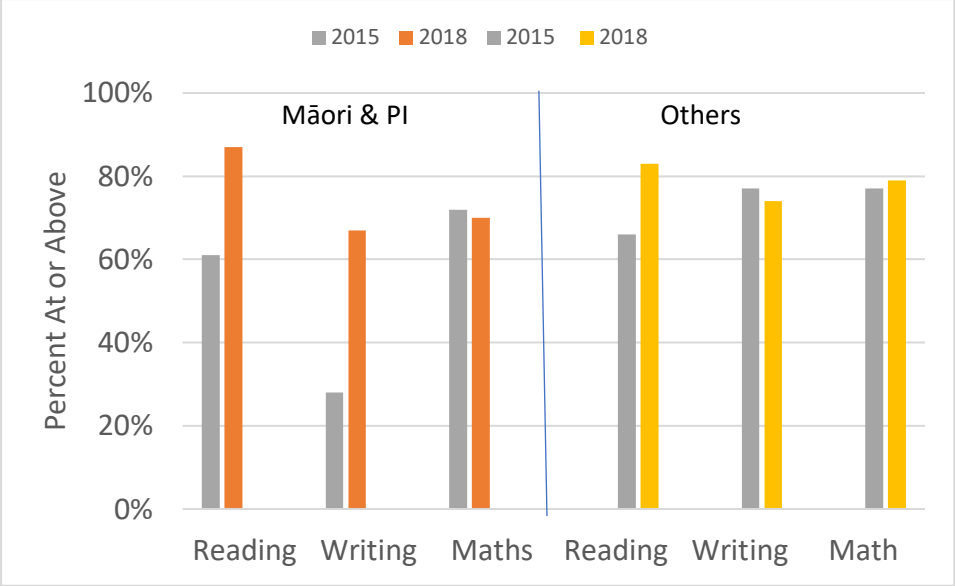


Figure 32 Change in meeting curriculum standards by ethnicity group in Study 3.

At the end of the project, girls were more likely to meet or exceed the standards in writing and reading, while boys were more likely to meet or exceed the maths standards. Māori were more likely to pass the reading standard and Europeans were more likely to pass the math standard, while writing was similar. In terms of neighbourhood deprivation, children from low deprivation neighbourhoods had higher pass rates in all three skill areas, with high deprivation neighbourhoods associated with lower mean scores, and mid-decile in between.

All of these results follow conventional research results, with the exception of the high performance of Māori in reading, which improved from 62.5% meeting or exceeding the reading standard in 2015, increasing to 88.9% during the third year of the strategies in 2018 (26.4% increase). Overall, the proportion of children failing to pass any standard fell from about one in every 8 children to one in every 15 children in the original study schools.

Replication Schools

The baseline group of children with clinical-level PTS symptoms had the lowest rate of meeting national standards at the start of the project in both the original and replication schools. The percentage of children with clinical PTS symptoms at the first measurement had low rates of meeting the national standards in both the original strategy schools and the replication schools (Figure 33).

After one year of strategies, the rates of meeting the standards have improved in all skill areas for children at the original strategy schools and at the replication strategy schools. However, at the non-strategy schools, the percentage of children with clinical PTS meeting national standards has not improved. Replication schools that implemented the strategies showed a similar pattern of improvement, over one year, while the contrast non-strategy schools did not improve (Figure 33).

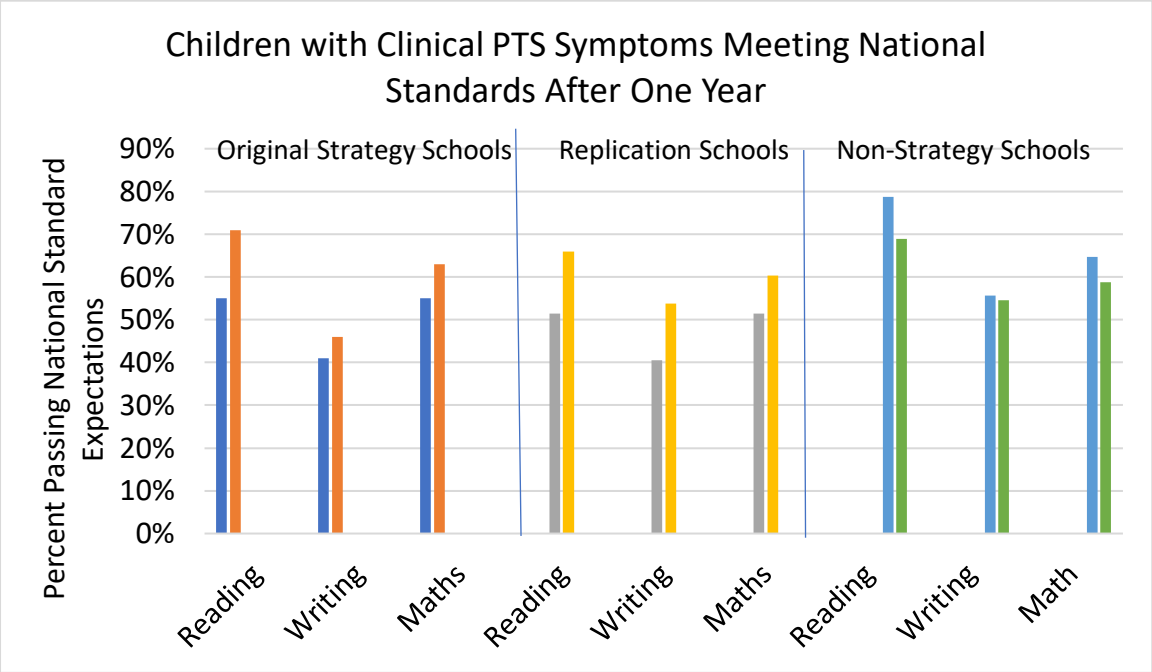


Figure 33 Effect of Strategies on Reading, Writing and Math across study groups.

The effects of the strategies on improving learning was outstanding. Although the Minister of Education announced that children's literacy had dropped during the period of time including the original step one strategies (Moir, 2017), the results from this project demonstrate improvement in learning.

School Deciles

Children with clinical-level PTS symptoms at baseline in the strategy replication schools showed improvements in meeting national standards except for writing in high decile schools, and there were no differences at T2 across school deciles (Figure 34). There were no significant improvements in contrast schools.

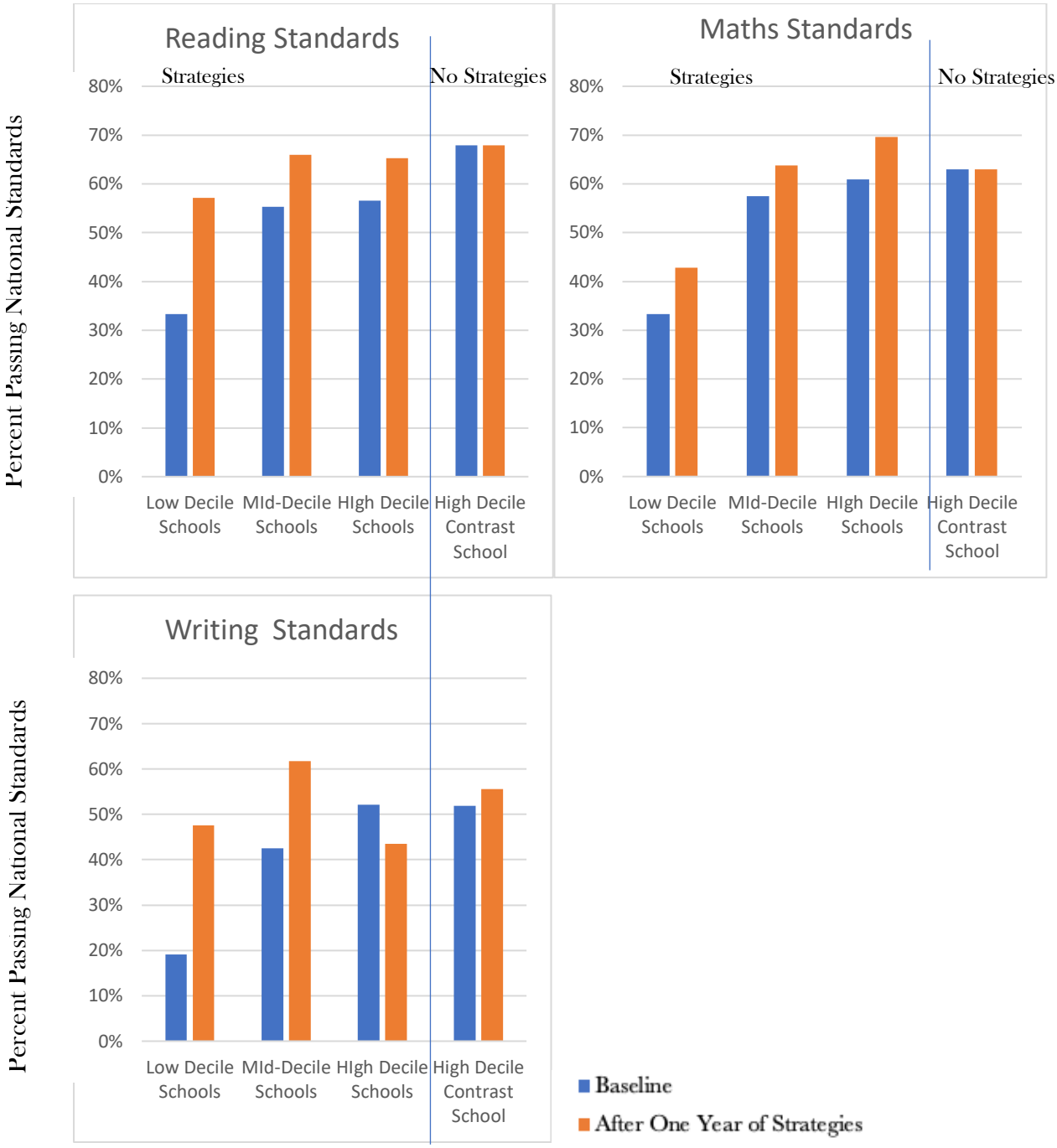


Figure 34 Effects of strategies on achievement by school decile in replication schools. Baseline clinical children, with the same children measured at each time point.

Non-Clinical Group

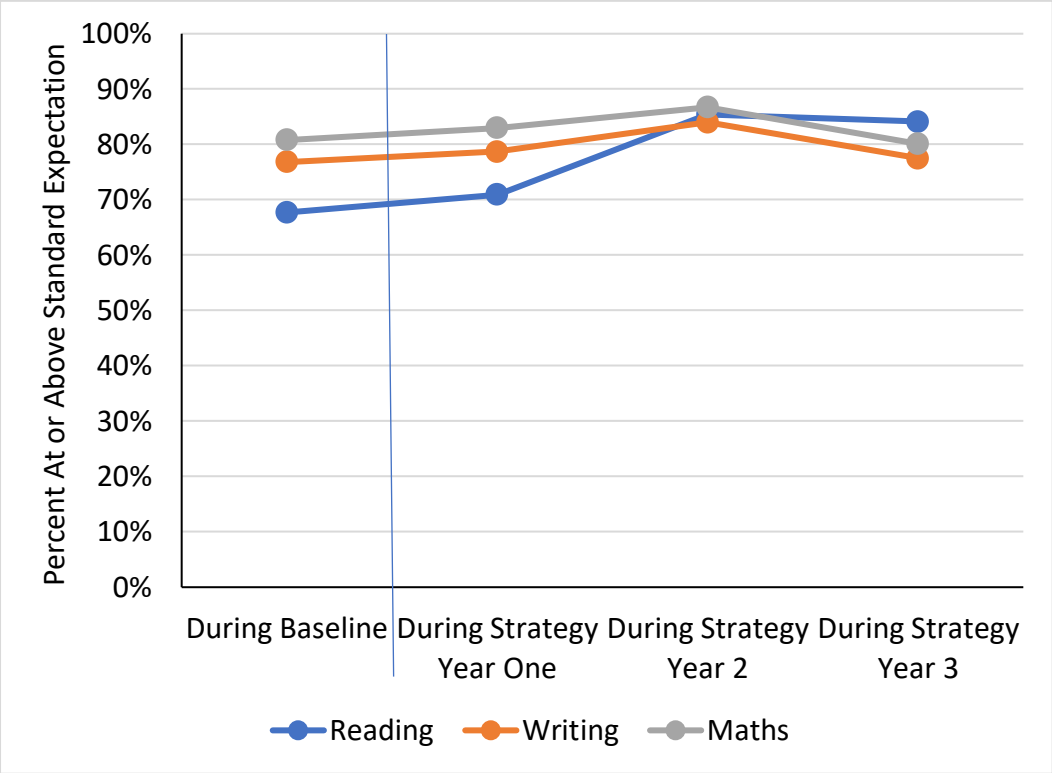


Figure 35 Effects of strategies on the reading, writing and math of children without clinical PTS.

Within the non-clinical group in the original schools, the rate of children meeting national standards showed a similar pattern of improvement, although at a slightly lower trend, as these children were doing better at baseline than the children with clinical PTS (Figure 35).

Across all study children in the original strategy schools, between baseline and the end of the project, there was an increase of children meeting the reading standard from 65.6% to 83.5%. Writing, which fell in the final project year, had an overall increase of 4.6%, and maths, had an overall increase of 1.3%. Children who had water bottles and children who participated in the Positive Coping programme were more likely to meet or exceed achievement expectations as compared with, respectively, children without water bottles, and children of the same year level in the same school who did not receive the Positive Coping Programme.

Teacher Expectations

Children with PTS symptoms, particularly those at a clinical-level, are likely to have difficulty learning, which is generally associated with the effects of PTS on language processing, memory, and developmental functions (Cook et al., 2017; Malarbi, et. al, 2017). This was documented at the baseline and considered in the design of the strategies. It was hypothesised that once the children's PTS symptoms reduced, and the per cent of children with clinical PTS reduced, and teachers developed new skills for working with children from the Step Two strategy, Reaching IN . . Reaching OUT, the overall measures of learning would show improvement.

During the second project year, RIRO was the principle new strategy for three of the original strategy schools and one of the original schools implemented RIRO in the third project year. Professional development sessions before the start of school was used to train teachers in RIRO strategies, and this training was well received.

RIRO may be evaluated by looking at Teacher Expectations for learning as they begin the school year, which is an early indicator of teacher-pupil relationships, as a more positive relationship would be associated with a more positive expectation for learning. Teacher expectations were measured at the start of each school year in the original schools. If teacher expectations for children's learning and behaviour are positive at the beginning of the school year, the research literature indicates that children's achievement and learning is likely to be higher, as compared with classrooms in which teachers have low expectations of children's behaviour and learning (Brault, Janosz & Archambault, 2014; Rubie-Davies, Hattie, & Hamilton, 2010; Sudkamp, Kaiser & Moller, 2012).

The impact of RIRO during the second project year in the original strategy schools can be identified with rising teacher expectations for children's achievement at the start of the second project year immediately after the RIRO training, followed by more children improving to meet the national standards during the second project year, as compared to children during the first project year (Figures 36, 37, and 38). These results conform to the existing research about the role of teacher expectations, and demonstrate the impact of the strategies, as the same children are followed throughout.

Achievement results during the third project year are compounded by the change from national standards to local school standards, so the change in standards may have impacted on the rate of meeting standards as shown in the project.

The improvements in learning were temporally related to the introduction of the RIRO strategy in the original strategy schools, as illustrated in Figures 36, 37 and 38. In three of the original strategy schools, RIRO was introduced at the start of the second project year and in the replication study, RIRO was introduced as part of the Step One Strategies.

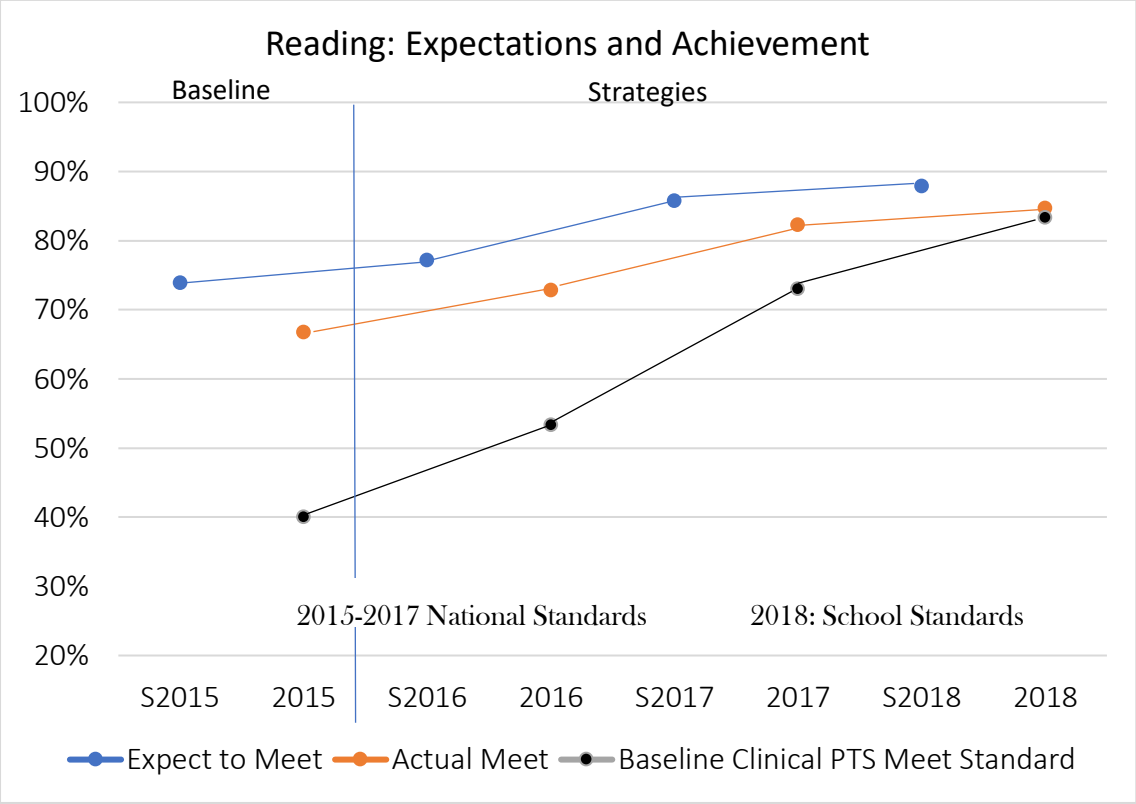


Figure 36 Effects of strategies on reading: Teacher expectations and child achievement

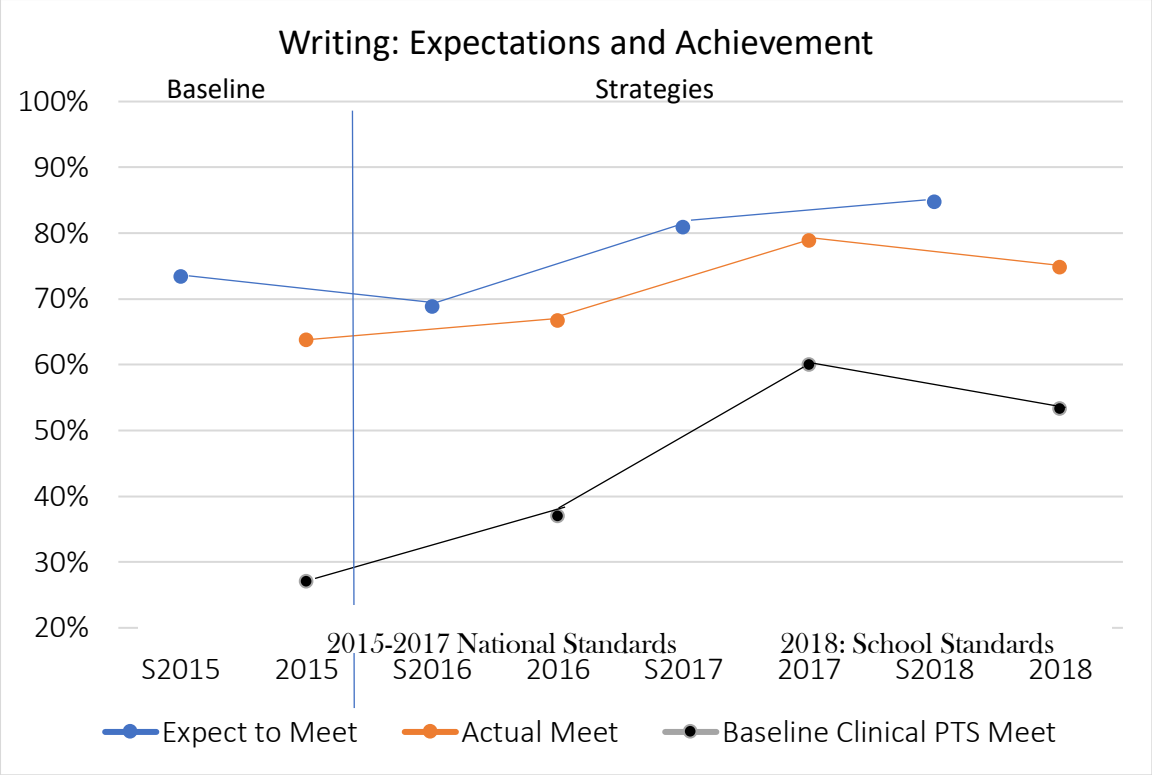


Figure 37 Effects of strategies on writing: Teacher expectations and child achievement.

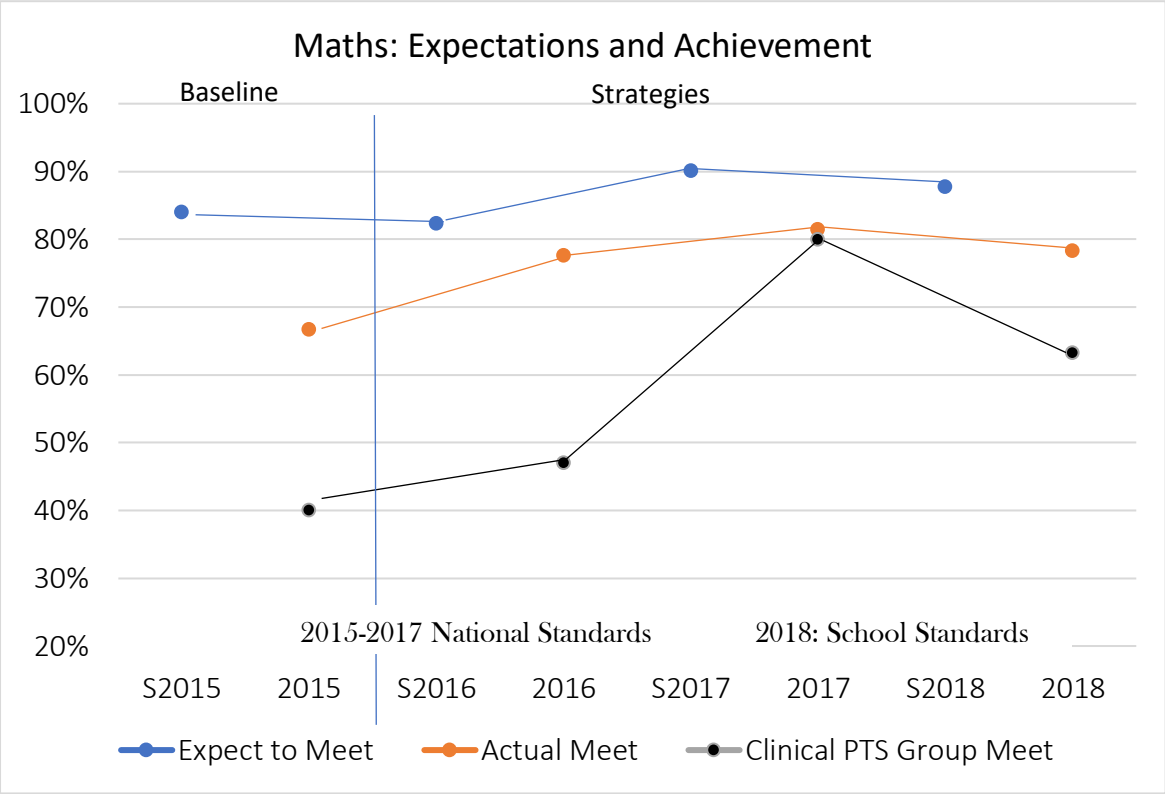


Figure 38 Effects of strategies on maths: Teacher expectations and child achievement.

Overall, RIRO is likely to have contributed to the significant positive changes for children's learning. However, due to the nature of the applied research, it is not possible to statistically separate the effects of RIRO from the effects of the other strategies that were implemented during this time.

Attitude to Learning

The impact of post-traumatic stress on learning has been relatively unstudied, but there is accumulating evidence that post-traumatic stress negatively affects cognition and characteristics associated with learning. This includes being able to learn in groups of other children and to have a positive interest in learning. Difficulties with learning may be associated with verbal processing, or with the impact of negative cognitions (e.g., believing a mistake on maths means that they are 'thick' or stupid or that they are unable to learn) or high arousal affecting the ability to concentrate on a learning task. A study of high school girls with PTS following Hurricane Katrina showed that PTS symptoms were related to their attitudes and overall dissatisfaction with school (Sims, Boasso, Burch, Naser, & Overstreet, 2015). Thus, enjoyment of school may also be reduced by the presence of PTS symptoms, and this may also negatively impact on learning.

Average attitude to learning scores showed improvements across the groups who implemented strategies, but not in contrast groups (Figure 39). There were no significant differences in the average scores for the attitude to learning measure between the replication schools and contrast schools at baseline, but the differences after the strategy implementation are significant ($p=0.031$), and show the same positive direction of change as in the original group.

As changes in cognition, such as attitude to learning, are theorised to follow the development of self-regulation, it would be predicted that changes to attitude to learning would lag behind changes in self-regulation. However, both have improved during the strategy implementation period, while the non-strategies contrast group are not improving adds strength to the positive changes associated with the strategies, and the negative impact of PTS symptoms.

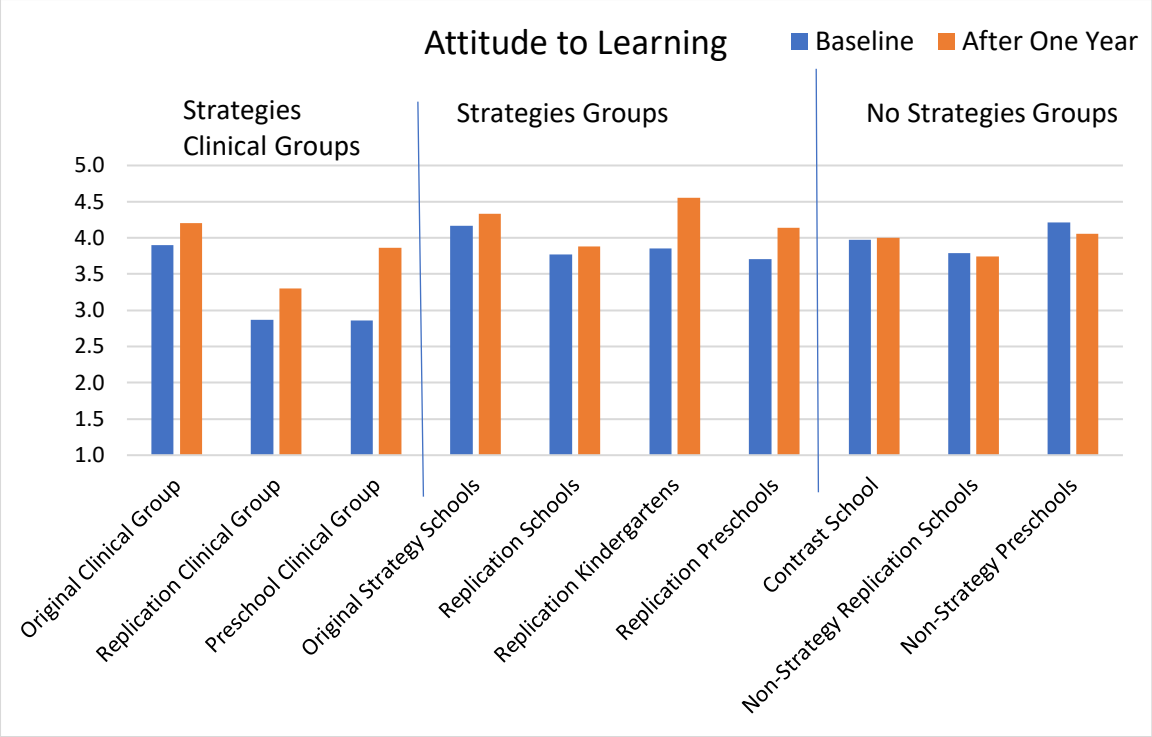


Figure 39 Effects of strategies on Attitude to Learning

Average mean item scores on Attitude to Learning items in study groups, at baseline and after one year of strategies.

Gender, Priority Ethnicity, Neighbourhood SES and School Decile

Within the clinical group from the original strategy schools, there were no significant differences at the end of the project according to gender (boys= Mean 4.2, girls=Mean 4.4) in attitude to learning. Similarly, although children with priority ethnicity had a higher Attitude to Learning score (Mean=4.5), this was not significantly different than the children of "other" ethnicity (4.1). Considering neighbourhood SES, the mean scores for low SES (4.2), mid-SES (4.3) and high SES (4.2) were not significantly different. A similar pattern was shown in replication strategy schools by gender.

In the original strategy schools, baseline clinical children from low decile schools had a higher, more positive attitude to learning score after one year of strategies (4.6) as compared to children from mid-decile (3.9) and high decile (4.19) schools.

In the strategy replication schools, attitude to learning improved in all school deciles, and there was a slight improvement in the high decile contrast school (Figure 40).

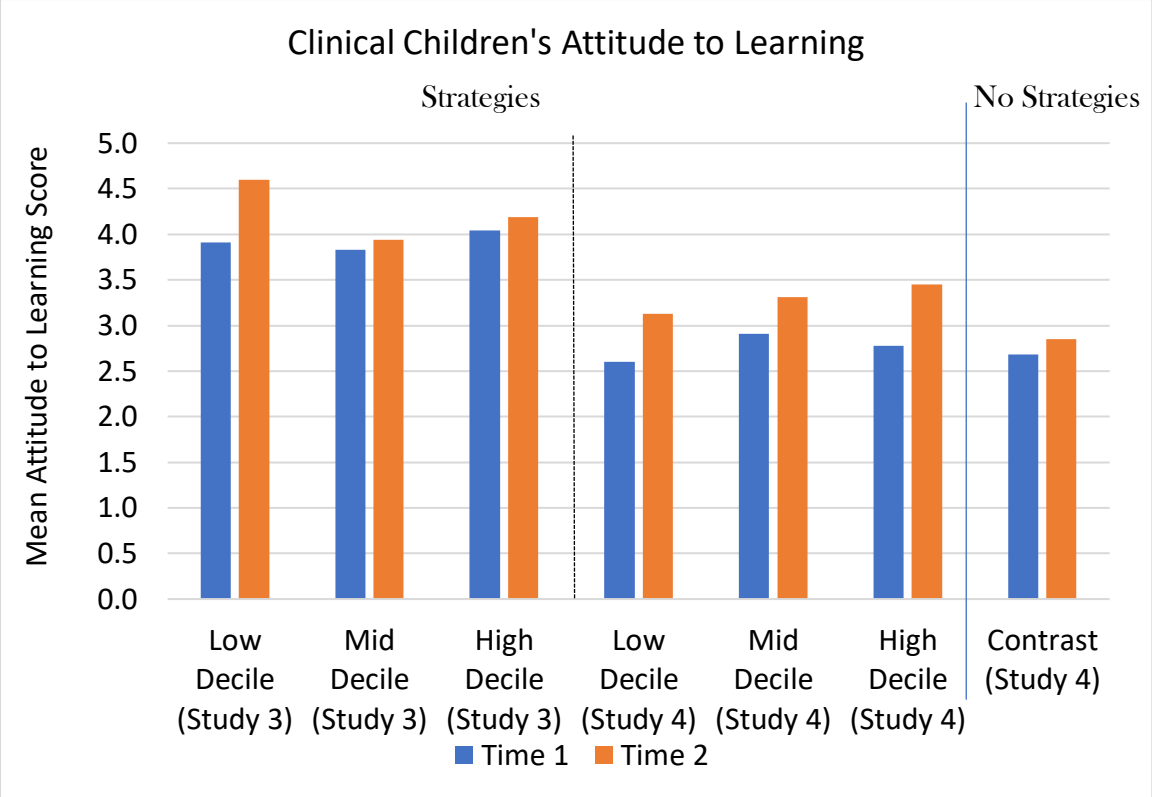


Figure 40 Effects of strategies on clinical children's attitude to learning by school decile.

Improvement to Attendance

As children's ability to cope with daily stressors improves, learning will improve, as shown in the results. As children find positive success with their learning and their attitude to learning improves, they should find attending schools a positive experience. Also, as children's coping and self-regulation improves, their physical health improves. Overall, it was hoped that the strategies would eventually improve attendance, although children's attendance is also based on parent and family factors.

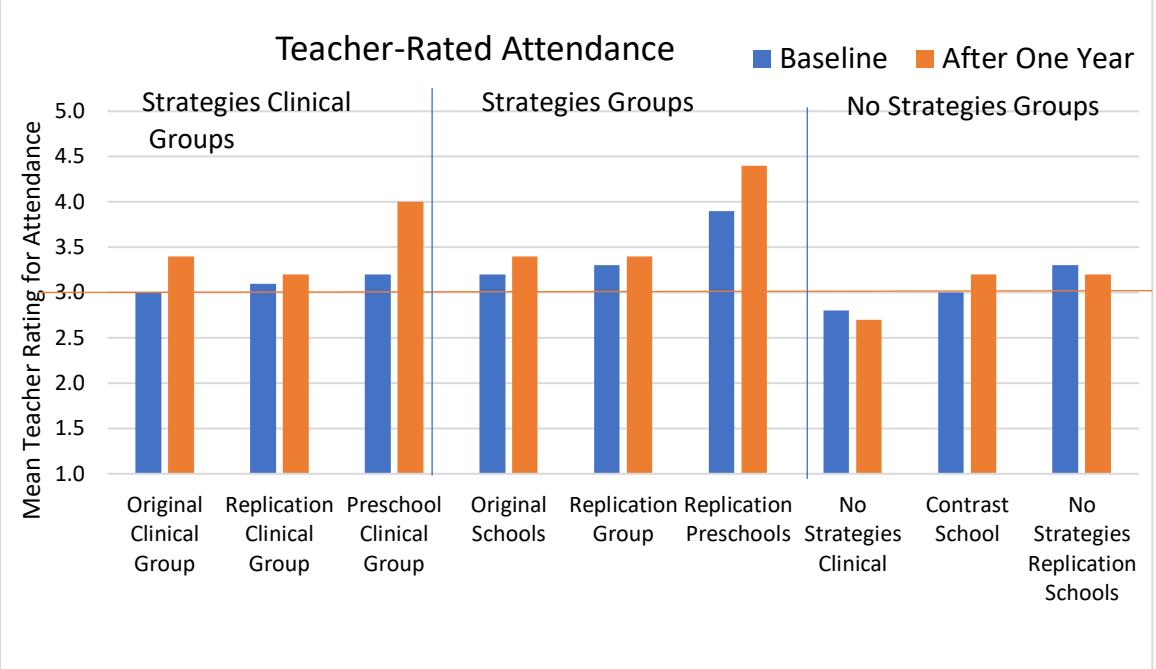


Figure 41 Effects of strategies on mean teacher-rating for attendance (a rating of 3.0 is considered average of peer group).

Overall, there were improvements in attendance in the children attending strategy-implementing schools (Figure 41), particularly in the clinical groups in the original strategy schools and the preschools. Although the high decile contrast school also showed improvements, attendance rating fell in the clinical group and the larger sample of the replication schools.

Within the original clinical group, there were no significant differences by gender, neighbourhood deprivation level, or priority ethnicity or school decile at the end of the project in mean teacher rating for attendance (but low school decile= 2.57, mid= 2.45 and high= 2.52).

School Decile

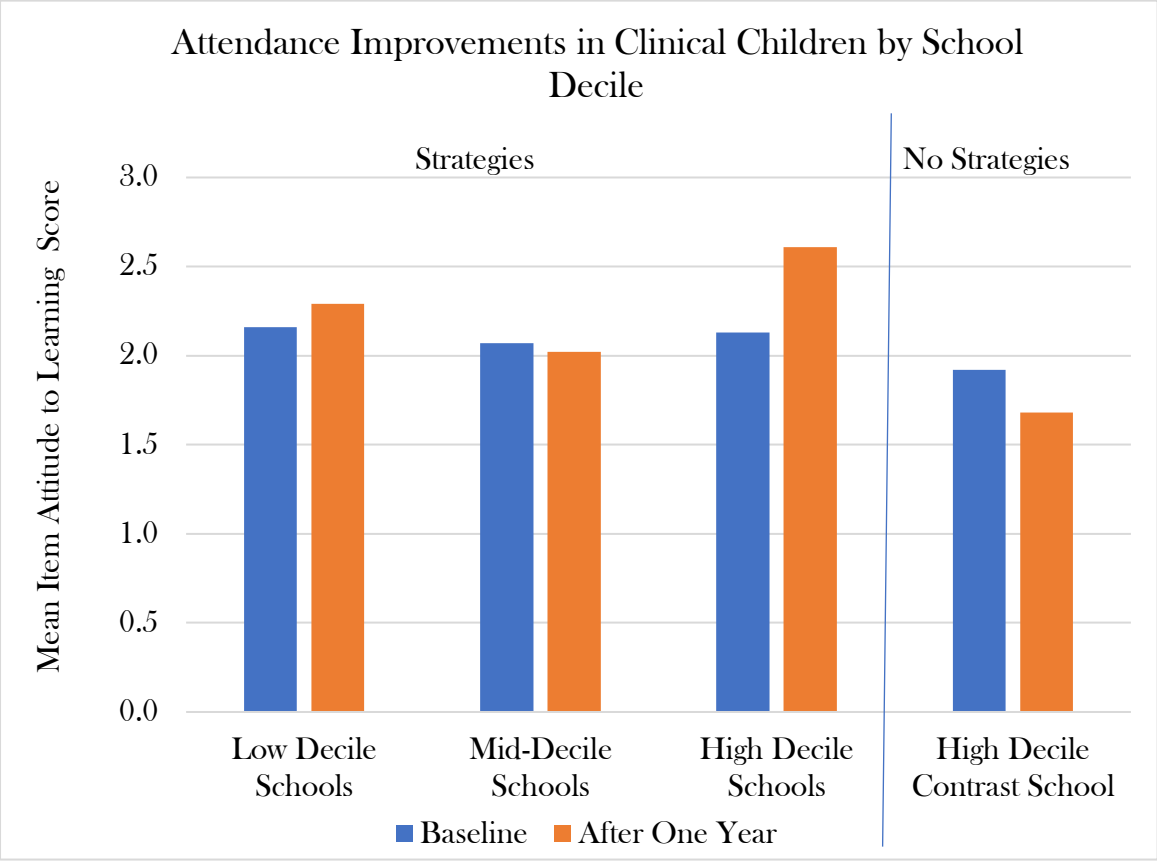


Figure 42 Effects of strategies on attendance by school decile.

Improvements in attendance ratings of clinical PTS replication group across school deciles (same children at each time point).

In the original schools, at the end of the project, there was no significant difference across school deciles (Figure 42) in mean teacher rating for attendance (but low school decile= 2.57, mid= 2.45 and high= 2.52). In the replication groups, there were some improvements, and the high and low decile schools' rating after one year of strategies were significantly different (p=.014), and the attendance rating at high decile strategy schools *and low decile schools* was significantly better than at high decile non-strategy schools (p=.002).

Contributions of Support Services and Enrichment

Of the clinical children in the original schools, 16.7% received neither support or participated in enrichment, 70% participated in enrichment, while 43.3% did both (for additional details, see Appendix 4). The mean PTS symptom score of the clinical children who did not receive support or participate in enrichment activities improved (Table 13), while those that received

support continued, on average, to be above the clinical cut-off. Thus, receiving support did not improve outcomes. This may be because children who have sleep problems are less likely to benefit from support (Blunden & Chervin, 2007) and children who continued with high PTS symptoms were likely to be suffering from sleep problems.

Considering all of the participants, 11.9% participated in neither support or enrichment, and 27.3% participated in both support and enrichment. Results for the non-clinical children had similar patterns.

Table 13 Effect of strategies plus support services and enrichment activities on PTS symptoms

Support and Enrichment	Baseline Clinical Children		Other Children	
	Baseline Mean (SD)	After Strategies Mean (SD)	Baseline Mean (SD)	After Strategies Mean (SD)
Strategies Only	8.00 (1.4)	1.20 (1.3)	1.80 (2.0)	1.67 (1.9)
Support Services plus Strategies	7.60 (1.7)	6.5 (1.9)	1.71 (2.0)	1.71 (2.1)
Enrichment Activities plus Strategies	7.25 (1.5)	2.00 (2.3)	1.10 (1.6)	0.86 (1.3)
Support and Enrichment plus Strategies	8.00 (1.6)	6.77 (3.4)	1.58 (1.7)	1.28 (1.6)

Implications. Support services were provided to children in the original strategy schools who had the most severe issues, and their impact is not clear. Both clinical children and others who participated in enrichment activities in the strategy schools showed reductions in their PTS symptom scores. It may be that participation in enrichment activities was related to the reduction in PTS symptoms (e.g., fewer symptoms, more likely to participate), or it may be that the enrichment activities contributed alongside the strategies to the reduction in symptoms. However, the fact that reductions in PTS symptoms were shown in children who received neither support nor participated in enrichment is an indication of the impact of the strategies. These are only indicators, due to the low numbers. Similar information was not collected in the replication study.

Impact of Strategy Intensity on Outcomes

The intensity of an intervention has been described as the number of hours, the number of sessions, and the overall length of time that a participant is engaged in or accesses the

intervention. An additional conceptualisation of intensity is the number of intervention elements in which the participant engages, particularly in tiered-interventions or intervention "packages" which consist of multiple elements (Barnett, Daly, Jones &Lentz, 2004; Fawcett, Collie-Akers, Schultz & Kelley, 2015).

In the present study, one aspect of intensity is the duration of strategy implementation, and the differences in the outcomes between Study 3 and Study 4 illustrate that the three-year period of implementation of strategies in Study 3 produced better outcomes than the one year implementation period of Study 4. However, implementing the step one and step two strategies in the same year did produce better outcomes as compared to the outcomes in study 3, but this may be due to differences in the characteristics of the participants.

A second aspect of intensity is the number of strategies implemented, particularly given the many strategies identified for step one. Assigning each strategy a nominal value of 1, the number of strategies that were reported as implemented by the organisations for two or more school terms were summed over one school year, and divided by the total number of strategies. The calculation for the Replication sites included RIRO strategies in addition to the step one strategies. There were four organisations which implemented 0% of the strategies (the contrast sites), five organisations implementing less than 40%, seven implementing between 40-49%, eight implementing between 50-59%, five implementing 60-69% and six implementing more than 70% (the highest rate was 83%). Only one school was within the band implementing 50-60%. As the previous analysis, reported in 2017, showed that schools implementing less than 60% had weaker outcomes, and to ensure a spread of schools across the implementation categories, a combined category of implementation between 40-59% was used in subsequent analysis.

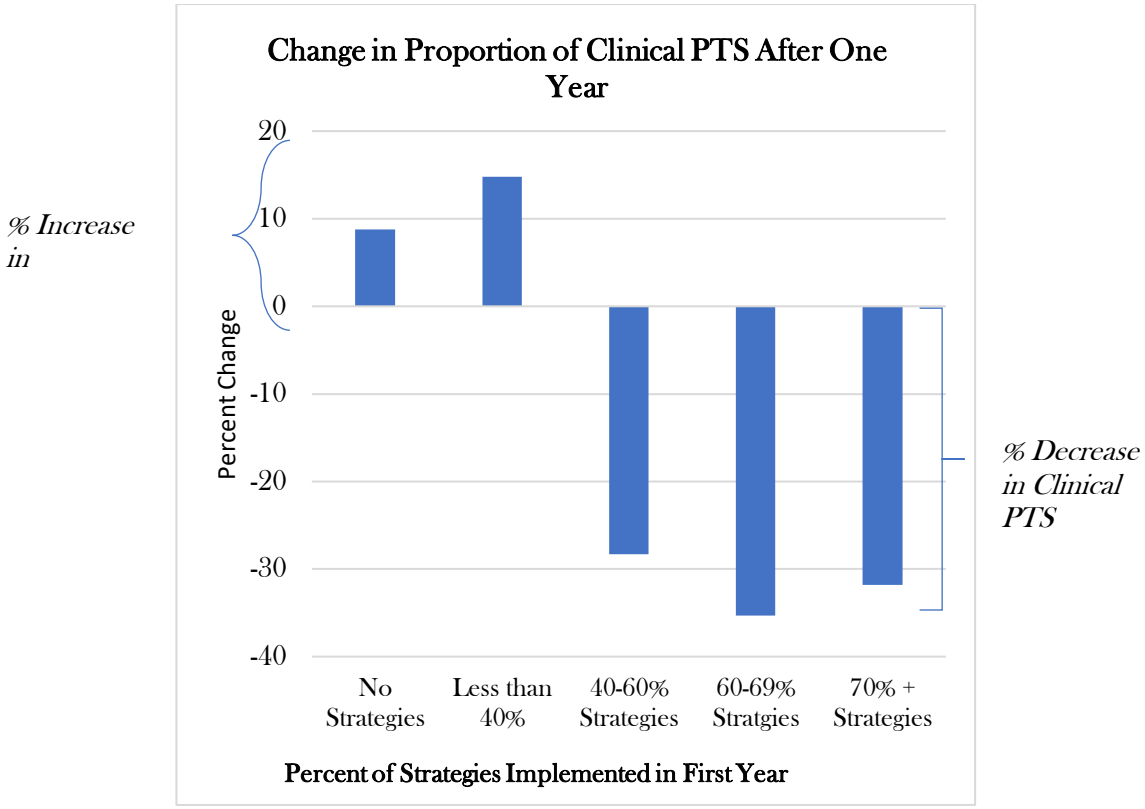


Figure 43 Effect of strategy intensity on percentage of children with clinical-level PTS symptoms

The analysis of changes in the percentage of children with clinical PTS-symptoms over one year by strategy implementation rates showed that sites with 0% and less than 40% implementation rates had increases in the proportion of children with clinical PTS symptoms (Figure 40, left side). However, sites that introduced more than 40% of the strategies had decreases of about 30% in children with clinical-level PTS symptoms (Figure 40, right side).

These results strengthen the evidence that positive outcomes are due to strategy implementation, with increasing intensity of implementation associated with increased gains, and replicate the pattern after the first year of strategies in the original schools (Liberty, 2017a).

In the replication schools, differences in mean PTS scores for all children by age at Time 2 show that the strategies were effective across all ages (Figure 44). In addition, better improvements are shown for children of the same age attending schools that implemented many strategies as compared to children of the same age attending schools with low implementation rates.

This is strong evidence that implementing a greater number of the strategies improved outcomes, even across all of the differences within the schools, kindergartens and preschools.

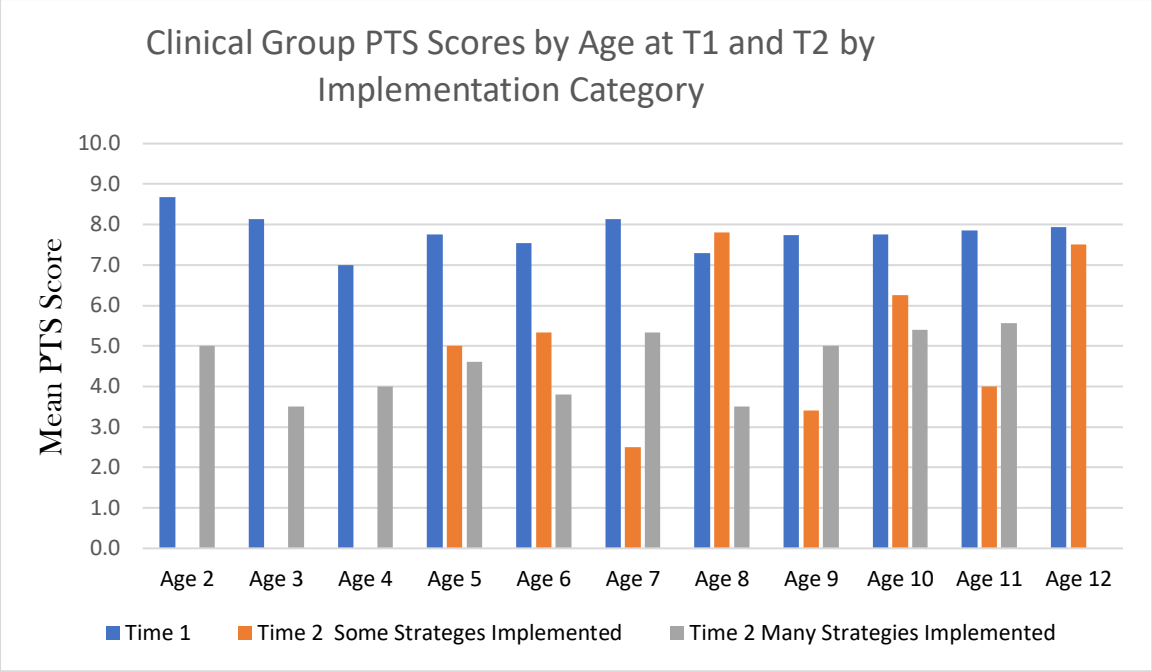


Figure 44 Effect of strategy intensity on PTS symptoms by age group in Study 4.

Effect-Size Analysis of Strategy Intervention

In this report, traditional statistical analyses have been used to demonstrate that changes were produced in the strategy-implementing schools but not in the contrast schools, and that these differences were not due to chance. However, this form of analysis does not answer the practical question about how much a difference. In a practical sense, to say that a change was not due to chance does not communicate the size of the difference that is achieved after implementing an intervention over a year requiring significant investment of time, effort and resources. What policy makers and leaders want to know is– did it make a difference? If so, how much of a difference?

One measure of effect size provides a metric of the impact of intervention by comparing pre-intervention to post-intervention outcomes. The comparison is based on the size of the change produced between the time points. Effect size contrasts with traditional statistics, which provide a probability estimate relating to the possibility that changes between pre and post-intervention measures were due to chance.

The Effect Sizes calculated in this report were derived from the Campbell Collaboration (Wilson, 2019). Cohen's *d* effect sizes are usually interpreted as 'no effect' (*d*=0.0 to .20),

small effect (*d*= .21-.50), moderate effect (*d* = .50-.80), large effect (*d* = .80 -.99) and very large effect (d≥1.00). For example, an effect size of *d* =1.0 would indicate that the intervention helped children, on average, to reduce their symptom score by about 1 standard deviation (a standard deviation represents about 34% of the population on either side of the mean). A comparison of effect sizes for other interventions is included in the Discussion chapter.

Effect Size for Post-traumatic Stress Symptoms

During the first year, the replication schools that used the strategies had a very strong pre-post ES in reducing mean PTS symptoms in clinical children, at original and replication schools (Table 14). This analysis includes all strategy implementing schools, even those with low implementation rates. The effect size for the reduction of PTS symptoms in clinical children has been analysed by school decile (Table 14). This shows that the effects were large in all deciles, and perhaps larger in high decile schools. Results were large across boys and girls, and for children with priority ethnicity (Māori and Pacific Island). Overall, the effect sizes for the Replication Schools indicate the impressive change obtained in one year.

The data indicate that the *Yes, I Can*! programmes contributed large effects to the gains in the original school group. The effects of the sleep programme in the replication school were smaller, perhaps because these were introduced during the fifth term of strategies, rather than after nine terms, as in the original schools (see Appendix 2).

Table 14 Effect size of strategies on post-traumatic stress symptoms in study groups

Reduction of PTS Symptoms in Clinical Children, Baseline to Final Measure, except as noted

Clinical Study Group	Study 3 Original Schools Cohen's *d* Effect Size	Study 4 Replication Schools Cohen's *d* Effect Size
All Clinical Children	1.23	1.28
Girls	2.44	1.29
Boys	.95	1.16
Priority ethnicity	1.38	
Low decile schools	1.37	1.01
Mid-decile schools	1.08	1.38

Clinical Study Group	Study 3 Original Schools Cohen's *d* Effect Size	Study 4 Replication Schools Cohen's *d* Effect Size
High decile schools	1.78	1.36
Follow-up		1.14
Kindergartens		1.61
Preschools†		2.24
Yes, I Can! Sleep Education	.84*	.63**
Yes, I Can! Sparkle Coping	.85**	.64**

* Compared with same children at the end of the previous school year.
** Compared with children in same classroom or hub who did not receive programme.
† Reduction in the proportion of children with low resilience, as explained in the text.

Contributions of Enrichment and Support to Strategies

In the original strategies group, 89 children participated in enrichment activities and did not receive support. The mean PTS score for this group of children reduced from 1.65 (SD=2.4) to 0.97 (SD=1.4), with a small effect (*d*=.36). As almost all of the clinical children received support, and the contribution of the support to the outcome is not clear, it is not possible to ascertain an effect size for the support services on the clinical children.

Effect Size for Self-regulation

Within the clinical replication group, the average self-regulation score showed moderate effects (*d*=.65), and the proportion of children with low self-regulation was reduced (d_{cox} =.76.). Within the non-strategy preschools, mean self-regulation scores declined (*d*= -.43), and the clinical children in non-strategy replication schools showed no improvement (*d*=.03).

Effect Size for Attitude to Learning

The effect sizes for the attitude to learning score in the clinical children in the no strategy schools and kindergartens were no effect and negative effect, respectively (i.e., *d*=.12 and d= –.24 for preschools), while there were moderate positive effects in the strategy schools and kindergartens (*d*=.61) and preschools (*d*=.50).

Effect Size for Learning

Within the original and replication groups, there were small effects on meeting the curriculum standards (d_{cox}=.31 - .33), but there was a large effect in the original group of meeting reading, from 55% to 83% over three years (d_{cox}=.87). In contrast, there were no effects in the non-strategy schools (reading= d_{cox} =.07, writing, d_{cox} =.19 maths, d_{cox} =.05). It is not clear if this was affected by the change from national standards to local standards.

CHAPTER 7. DISCUSSION

The Positive Changes

The results show strong positive effect sizes of strategy implementation over three years for the reduction in PTS symptoms for children with clinical high rates before the introduction of strategies, for improvement in self-regulation, attitudes to learning and meeting curriculum standards (learning). The positive results were replicated with a large random sample of children from 30 different organisations.

An overview of PTS symptoms in the children illustrates the positive changes (Figure 45). The mean scores of PTS symptoms of children in schools without strategies, shown previously in Figure 4, can now be updated and contrasted with the lower mean scores of children attending strategy schools.

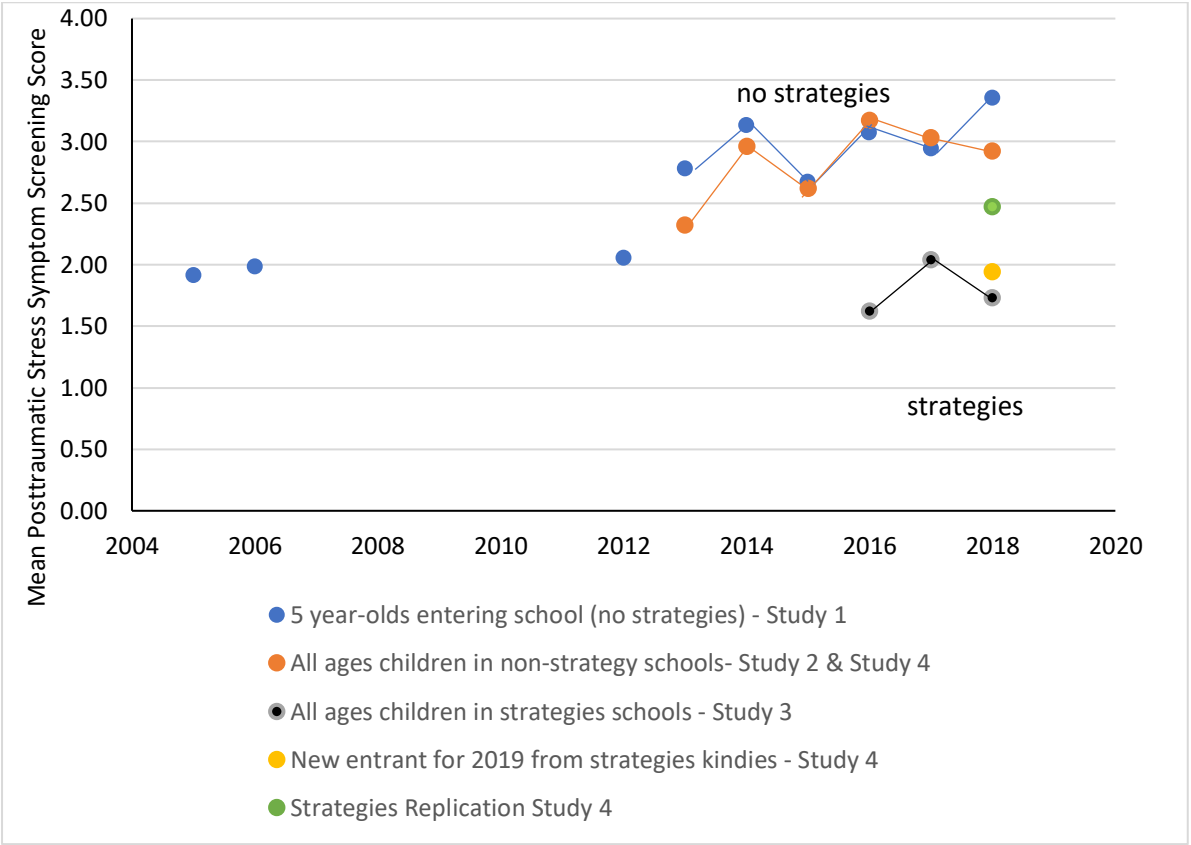


Figure 45 Effects of strategies on mean PTSD symptoms of all children across study years

The Effect Sizes (Table 14) also provide an important level of evidence that the strategies were effective in reducing PTS symptoms across different demographics.

Improvements were shown across all for boys and girls, children of priority ethnicity and other ethnicities, in low-, mid- and high- decile schools, in schools, kindergartens and preschools, in all age groups and for children with high PTS symptom scores and those with low symptom scores.

In the original schools, the results have improved with the implementation of the third-year strategies, particularly the *Yes, I Can! Sleep Education* programme, and show stronger effects commensurate with three years of implementation as compared with one year of implementation in the replication sites, and no implementation in the contrast sites. The gradual change over time aligns with research on protective factors, which have a cumulative

As further evidence that changes are due to strategy implementation, children in schools and preschools that did not implement strategies maintained high rates of PTS and low rates of self-regulation, learning, and attendance. Findings are strengthened by demonstrating the strong relationships between implementing strategies and the results. The results demonstrated the differences between schools implementing strategies showing improvements while schools that had not implemented any strategies either showed a worsening of PTS rates or a holding pattern. This effect was duplicated in the replication schools.

Improvements are not due to maturation

Due to the initial cohort study design which established the mental health baseline and the longitudinal study in the original schools, as well as the randomised replication study, there is strong evidence that changes are not due to maturation:

If maturation were the cause of the observed changes, children in the replication schools would have much lower symptoms at the baseline, having matured over the same length of time as children in the original study group.

Similarly, if maturation were the cause of the observed changed, children in the contrast schools would show the same changes over time as children in the strategy-replication schools. However, there was no statistically significant similar improvements were shown in children in the contrast groups, which have children of similar ages.

There were no significant differences in improvements by age at baseline, so that improvements are not related to a specific age.

Thus, there is strong evidence that the changes are not due to maturation.

Improvements are not due to the passage of time since the earthquakes

Similarly, the strong design features counter arguments that children have improved simply due to the passage of time since the earthquakes.

Some research with older children indicates that there can be a natural decline in symptoms as time since the earthquake passes, especially in those who had lower exposure to earthquake stressors such as seeing damage first hand (Geng et al., 2018). As children's PTS symptoms were not assessed until they entered school, it is not possible to determine which children may have never had PTS symptoms from children who had symptoms immediately after the earthquakes and then recovered before they started school.

However, the argument that the data simply reflect a decline in symptoms over time during the study period is countered by the fact that there was no significant declining trend in contrast non-strategy sites or in five-year-old children entering school during the entire study period (Figures 4 and 45).

At the baseline of Study 3, 46.78% of children had low or no symptoms. By the end of the project, three years later, 81.8% had low or no symptoms. If this improvement was due to the simple passage of time since the earthquakes, then there would be a similar expectation for this level of improvement in the replication group over the same time period. This didn't happen. The same improvement was not shown in the replication group in either the strategies or the contrast schools. It is not the passage of time that has caused the improvements in the children attending the original strategy schools who participated in Study 3, documented in this report.

Additional Evidence

There is additional strong evidence to date that the positive changes are the direct result of the strategies:

- The changes are associated with the implementation of the strategies across all implementation sites.

- Strategies implemented across 22 educational organisations produced the same type of positive changes, while the contrast non-strategy organisations showed no positive changes.
- All educational organisations had previously implemented programmes, or were implementing programmes (e.g., Positive Behaviour for Learning) and continued to implement programmes (e.g., Innovative Learning Environments), and the strategies were effective in all schools regardless of the implementation of these programmes, but more effective if schools implemented more of the specific strategies.
- Strategies were implemented in three different years, and during different school terms, with similar results. Thus, it is unlikely that the changes were due to some community events, or to more short-term school programmes.

There is sufficient evidence to strongly support the effects of the strategies in improving the wellbeing of children in the strategy schools who had had levels of post-traumatic stress symptoms. This is more evidence than is available to support the effects of the implementation of other interventions in this earthquake-affected community.

Comparison of Strategies with Other Interventions

Interpreting the results of this natural experiment is limited by a failure to identify a suitable comparison in the published literature. Although it is perhaps inappropriate to compare the results of a natural field experiment with results of other school-based studies which may have more experimental controls, this approach has been followed in order to put the findings in perspective.

Comparison of Strategies with Interventions for PTSD

Rolfsnes and Idsoe (2011), in a review of school-based interventions for PTSD, identified only one intervention following an earthquake. This was manualised trauma-focused grief psychotherapy delivered at school locations by mental health professionals delivered in small groups to adolescents (aged 12-13 years old), following an earthquake in Armenia. This psychotherapy had effect sizes of d=.07 immediately following treatment (6 d= 1.29 at three years post-therapy and d=.69 at a five-year follow-up. The long-term effect sizes are similar to the present study. However, the small group trauma-focused CBT intervention would not be possible to be delivered in Christchurch, due to the ratio of mental health professionals to need (see Chapter 2).

Guttermann and colleagues (2016) considered more than 13,000 articles and then carefully reviewed 135 studies that met quality-standards for inclusion in a meta-analysis of psychological treatments for PTS symptoms in children. These studies, with more than 9500 participants (up to age 25) and 150 treatment conditions identified an average effect size of 0.89 for pre-post treatment reductions in PTSD symptoms in children and adolescents. In studies that included randomised controlled trials, the effect size was 0.60. The researchers concluded the average effect size for PTSD reductions was 0.89 (Gutermann, et al., 2016). The most-researched intervention was trauma-focused cognitive behaviour therapy, and this yielded the largest effect sizes. Also, older children had larger effect sizes as did individual treatments. Interestingly, one study included meditation/relaxation interventions, and reported a negligible effect size of *d*=.14.

Pfeferbaum, Varma, Nitema and Newman (2014), in a review of whole -school interventions, identified that whole school interventions had only been studied as preventative interventions (i.e., before an adverse event) while after a traumatic event, interventions were almost entirely CBT-based and delivered in groups to targeted students. These were school-based only in the sense that specialists delivered the therapy in a school setting rather than a clinic setting.

Similarly, Brown and colleagues (2017) identified 36 studies, 15 of which were conducted after natural disasters. Of the studies, interventions included CBT, EMDR, narrative exposure therapy and a classroom-based programme. The classroom-based programme, ERASE-Stress, which had been evaluated in several studies, was a 12-15 session programme delivered by a trained classroom teacher as part of the school curriculum aimed at reducing PTSD in war-affected Israeli seventh and eighth- grade students, age 12-15 years. This programme produced moderate to large effects in reducing PTS symptoms but was not comparable to the present study due to the context of war and difference in age range.

The effect sizes of the present study are comparable to those achieved with CBT. However, the strategies were implemented over a longer time period, but were more do-able, due to the lack of sufficient mental health personnel to deliver CBT to those needing treatment in Christchurch (Chapter 2).

Comparison of Strategies with Interventions for Self-Regulation and Learning

A recent meta-analysis of 49 studies of interventions designed explicitly to improve self-regulation reported a pooled effect size of d=.42 (Pandey, Hale, Das, Goddings, Blackemore &

Viner, 2018). Considering that our intervention was not designed to improve self-regulation, and it was a secondary outcome, the effect size for self-regulation of the present study (d = .50-.61) as compared to the average of the meta-analysis. Overall, the strategy impact in the present study compares favourably with the effect sizes reported for individual and small group therapy for improvement in self-regulation.

A meta-analysis of 40 years of interventions for struggling readers identified an effect size of d=.23 for studies published since 2005 (Scammacca, Roberts, Vaughn & Stuebing, 2015). The present intervention did not specifically target academic skills, but the reading skills of children in the clinical group improved with a large effect size after three years, but a smaller effect size after one year, and both effect sizes are larger than that in the meta-analysis.

Comparison of Strategies with Other Interventions in Earthquake-Struck Communities

The results of this natural experiment are difficult to contextualise within the existing literature. However, as a starting point, four recent interventions for earthquake-affected children are considered for purposes of establishing a comparative position with the present study. For each study, an effect size (Cohen's d) has been calculated, using the mean pre-post scores on the PTS measure reported by the researchers, or an equivalent-type measure.

Children in Bío Bío Chile were scheduled to receive a universal mental health intervention, "Skills for Life", at the start of school, but just before the start of school, an M8.8 earthquake occurred, in February 2010, followed by a tsunami and looting. This intervention (Garfin, et al., 2014) involves children, teachers and parents, and focuses on helping all children be resilient. It includes 10 two-hour session covering study skills, conflict resolution and time management for all children. Children who are screened as being at risk for psychopathology receive 15 additional group sessions from psychologists and other trained professionals about how to reduce stress, for example. Teachers receive training in how to provide a "more supportive classroom environment", and parents participate in three sessions in which they learn about family factors that can increase risk, effective communication, and to communicate with teachers, and help children develop a positive self-identity. In addition to the universal intervention, 33 children received another intervention ("crisis intervention, support groups, information on coping strategies") intended to reduce PTS symptoms; these interventions occurred 3-6 months after the earthquake. Researchers studied the children and assessed their symptoms 9 months later. Although the delivery of the intervention was so soon after the

earthquake, the similarities with the present study warrant including it in this review. The screening conducted at the end of the year before the earthquakes provided a baseline of PTS symptoms. However, unfortunately, the researchers do not provide mean scores of the children at the 9-month measures which could be used to determine effect size. Instead, they report the percentage of children above the clinical cut-off on their screening measure, which was 28.8% in the group that received the universal intervention only and 18.92% for those that received the intensive intervention, but this difference does not produce a meaningful effect size (d=.009)., and without a measure after the earthquake and before the intervention, it is not possible to determine the pre-post effects.

A study of high school students who experienced the Great Japan Earthquake and Tsunami of 2011 included offering students an intervention based on a similar model to ERASE, which included elements of CBT, mindfulness, relaxation training, and coping skills (Okuyama, Funakoshi, Tomita, Yamaguchi & Matsuoka, 2017). The researchers screened about 240 participants, and those who met screening cut-offs were able to access individual help from teachers, deputy principals, school nurses and school counsellors at two high schools. There were a variety of activities to reduce psychological issues, decrease symptoms and "revitalise" schools. Psychiatrists worked with referred participants identified as the highest risk, and the teachers of these students received additional monthly psychiatric consultations. The Impact of Event Scale-Revised was used by the participants to report their symptoms. The intervention was initiated once 16 months post-earthquake with 44 participants who only received it during this period and then again 28 months after the earthquake with 50 students who received the intervention in 2012 and 2014. This group represents children receiving the most intensive intervention, and the researchers identify that this group had the highest baseline scores, and this used as an indicator for comparison purposes. However, the effect size of d=.20 (Table 9) is on the borderline of the no effect range.

A completely different intervention, identified as non-verbal art and play activities, and suitable for grade four students (61.8% girls) who had experienced the Sichuan Earthquake, was delivered about once per month by teachers specially trained by creative arts teachers and therapists (Ho, Lai, Lo, Nan & Pon, 2017). Individual children were referred for specialist support to the supervising therapists. Teachers designed and/or selected activities such as painting, making puppets, movement games, dancing, encouraging children to think about hope, care and other positive thoughts, and included sharing artwork, singing, and breathing activities. Researchers used a validated six-item measure of anxiety, administered to the

children in their classrooms. Although Ho, Lai, Lo, Nan and Pon (2017) report that there were no statistically significant results, a pre-post effect size analysis shows a small effect.

Following a large earthquake in Italy, Trentini and colleagues (2018) researched the implementation of an 8 step-manualised model of Eye Movement Desensitising and Reprocessing therapy delivered to school children aged 5-13 immediately after the EQ. The eight steps were completed in a single session of 60-90 minutes and delivered to a group of 11 children by two specialists per group. Each group received three cycles over three weeks. Children self-reported their PTS symptoms using the Children's Revised Impact of Event Scale (CRIES-13). According to the authors, boys and younger children showed fewer effects, and young children's anger expressions increased over time. The effect size was strong, d=.65.

A comparison of the effects of interventions for children in earthquake affected communities indicates that the strategy studies discussed in this report have stronger effect sizes (Table 10). The strategies intervention package was implemented over a long period of time, and this intensity may have contributed to the strength of the results. However, differences in methodologies, community contexts, and many other factors likely also contributed to the differences.

Table 15 Comparison of strategy effects with other strategies in post-earthquake communities

Comparative Factors		Okuyama et al. 2017 [Japan]	Ho et al., 2017 [China]	Trentini et al 2018 [Italy]	Study 3 Strategy Project	Study 4 Replication Project
Earthquake	Identifier	East Japan Earthquake & Tsunami	Sichuan Earthquake	Umbria Earthquake	Canterbury Earthquakes	Canterbury Earthquakes
	Country	Japan	China	Italy	New Zealand	New Zealand
	Date	March 2011	May 2008	2016	2010	2010
	Magnitude	M9.1	M8	M 6.2	M7.2	M7.2
Study Children	Number of Children Receiving Intervention	94	60	323	182	Preschool: 295 Kindergarten 91 Schools: 996
	Age of Children	15-16	10-11 (Grade 4)	5-13	8-11 years	Preschool 2-4 years Kindy 2-4 years Schools: 5-13 years
Intervention	Delivery	Teachers, school nurses, school counsellors with psychiatric support	Teachers trained by arts and play therapists	Specialists	Teachers	Teachers

Comparative Factors		Okuyama et al. 2017 [Japan]	Ho et al., 2017 [China]	Trentini et al 2018 [Italy]	Study 3 Strategy Project	Study 4 Replication Project
	Tier-level	Tier3 Targeted individual	Tier 2 Targeted group	Tier 1 Everyone	Tier 1 Everyone	Tier 1 Everyone
	Intervention	Individualised mental health support at school	Arts and play-based support in groups of 30	Three sessions of EMDR, in groups of 7-24	15-18 Strategies directed at Neurophysiological basis of PTSD implemented over 3 years	Combined year 1 and year 2 strategies
	Change Time Period	2 years 2012 and 2014	2-3 sessions during 1 semester 2009-2010	3-4 weeks immediately after EQ	3 years (2015-2018)	1 year (2017-2018)
Effects	Pre-Post Change in Symptoms	PTS 21.4 (20.6) to 17.4 (18.7)[a]	Generalised Anxiety 10.20 (2.71) to 9.27 (2.46)[a]	PTS 20.21 (17.63) to 9.88 (13.71)[a]	PTS 7.68 (1.44) to 4.53 (3.65)	Resilience Preschool: 2.32 (.53) to 3.68 (.82) PTS Kindy: 7.93 (1.21) to 3.89 (3.76) School: 7.80 (1.43) to 4.98 (3.2)
	Effect size (Cohen's *d*)	0.20	0.36	0.65	1.23	Preschool: 2.24 Kindy: 1.61 School: 1.28

a. Sources: Okuyama et al. 2017, Intensive group (Group 4, Table 3); Ho et al., Table 2; Trentini, 2018, Table 2.

The comparative analyses presented above shows that the strategies had an effect equivalent to many studies of individual therapies for child PTSD, which are typically thought of as "best practice, and stronger results as compared to other reported school-based interventions in earthquake-affected communities. This indicates that the effect reported is very strong, and a testament to the superior efforts of the teachers, principals and parents and the responsiveness of the children.

Zakszeski, Ventresco, and Jaffe (2017) have critically reviewed school-based interventions and identified the need for new approaches to helping children. This is because the existing approaches "incorporated largely reactive, direct services to students provided by external clinicians or researchers" (p.316). In particular, the researchers identify the education of school personnel about the effects of traumatic events, not only in terms of improving adoption of strategies but because "student outcomes may differentially improve and sustain when interventions are implemented by school personnel with whom students have consistent contact." (p. 317).

The strong results of the current study are an indication that the different approach to addressing the mental health impacts of earthquakes can be achieved in whole-school approaches, and meet the requirements that Zakzeski, Ventresco and Jaffe (2017) advocated. The specific strengths of the strategies are discussed in the next section and these may add explanations to help elaborate on their strong effect.

The Strengths of the Strategies

Address neurobiological symptoms to promote health

A major strength of the approach described in this book is the innovative combination of evidence-informed strategies (e.g., "Drink to Think" and "Play-Eat-Learn") to address the neurobiological symptoms of post-traumatic stress of children who had experienced a very extended period of earthquakes, floods, and other disaster-related events. In particular, the strategies address the dysregulation of the Autonomic Nervous System (e.g., affecting digestive systems and causing dehydration, headaches and stomach aches, affecting arousal and causing behavioural, attention and learning difficulties).

The interventions used in the present natural experiment have been associated with improvement in cognition and mood (i.e., brain functioning) in recent studies. For example, "Drink to Think" promoted increased hydration, and Young and colleagues (2017, 2018)

reported that hydration with 150 ml water to individuals in a 30°C environment produced significant positive changes in the parts of the brain associated with stress, including the amygdala, and improved mood and cognitive function. In another recent study, children aged 9-12 showed improved cognitive function after four days of increased hydration in a recent clinical trial (Khan, et al., 2019). These studies support the possibility that the "Drink to Think" component of the intervention contributed to the positive results.

Omega 3 supplementation for some children may have similarly contributed to the positive findings. McNamara et al., 2016. Reported that depressed adolescents showed improvement in brain function and symptoms following omega 3 supplementation. Recently, children with ADHD have been shown to have disrupted circadian rhythm (Coogan & McGowan, 2017) and omega 3 has shown promise in re-regulation of dysregulated circadian rhythm in children with attention problems associated with ADHD (Buchhorn et al., 2017). Although children in the present study were not assessed for ADHD, there is overlap in the symptoms of inattention and sleep problems. Thus, it is possible that omega 3 supplementation may have contributed to the positive findings of the present studies.

In the USA, where schools provide lunches, "reverse recess" (i.e., Play-Eat- Learn) has been associated with increased fruit (Chapman et al., 2017) and milk intake (Hunsberger et al., 2014). Milk contains omega 3 and water, so this increased intake fits with the goals of the present programme. In the United States, the United States Department of Agriculture, the Centres for Disease Control, the Academy of Nutrition and Dietetics, the Society for Nutrition Education and Behavior, and the School Nutrition Association all now recommend scheduling play time ("recess") before lunch. (Hayes, Contento & Weekly, 2018). Athough the present study did not assess nutritional changes, it did assess behaviour changes that have been associated with changing the schedule. These reports indicate that Play-Eat-Learn may have contributed to children's reduced PTS symptoms.

Factoring the biological impacts of trauma in the design of classroom environments have been identified as an approach to ameliorating the effects of early traumatic experiences (Ahmed & Alsaleh, 2019; Gapp et al, 2016). Calm environments promote feelings of safety and security, which are the recommended attributes of trauma-informed schools (Dombo & Sabatino, 2019). Similarly, compassionate teaching is also an important component of trauma-informed schools (Jennings, 2018). These studies indicate that the interventions to calm the classrooms

and promote positive relationships (RIRO) are likely to have contributed to the positive effects of the strategies.

The strategies may also have been strengthened by a focus on research in the biological correlates of PTSD in children. The information from biological psychiatry indicates that children who have PTSD will have difficulties with some of the activities used in other interventions. These include

- using language to describe their inner states/emotions in response to questions from therapists,
- remember complex verbal instructions, such as those involved in engaging in meditation,
- re-experience traumatic events, such as in interventions involving re-enactment and/or
- reflect upon and explain their symptomatic behaviours.

Children who are not able to successfully participate in interventions involving such activities may display increased stress symptoms if they disappoint others or themselves because they are not able to complete the required activities successfully, or they may drop out or discontinue participation, or the effects of the intervention may not persist (Dalgleish, Meiser-Stedman & Smith, 2005).

However, additional long-term and controlled research studies are needed to explore the effects of a combined strategy intervention in disaster-struck communities, as current evidence as to impacts in communities where individual and small group psychotherapy is in insufficient supply to meet population needs (Smith, Dalgleish & Meiser-Stedman, 2019).

Long Term Sequential Approach

The biological psychiatric research indicates that child PTSD is persistent with long-lasting complex effects, and that was definitely shown in the persistence of PTS symptoms in children entering school in the present study (Figure 4), yet most interventions seem to be very short-term, and the research on intervention effects indicates the limitations of these approaches. A strength of the intervention is the long-term sequential approach to improving child health and symptom reduction. Even one year of strategies had a strong effect, but this may be because other interventions reported in earthquake-struck communities were for a far shorter time period.

Intensity of Intervention Implementation

Intensity of intervention, or intervention "dose", has long been a keystone concept related to intervention outcomes with regards to, for example, speech therapy (e.g., Baker, 2012), remedial reading (e.g., Schmitt & Justice, 2012) and early intervention for autism (Granpeesheh et al., 2009).

Intensity can be conceptualized as a function of time over which the child is 'dosed' with the intervention. In the present study, the continuing children experienced the intervention each school day, for at least one school year in the case of the replication study, and three years for the original study. This is a much more intense "dose" than the other interventions evaluated (Table 10).

Another conceptualization of dose has to do with the number of strategies implemented in the current strategy studies, with more strategies conceptualised as a more intense dose. There appears to be a "critical mass" of strategies, about 40% or more needed to achieve strong results, although some schools had effects implementing fewer strategies. The best outcomes are associated with implementing 60% or more of the strategies.

The study intervention's graduated effects associated with increasing the number of strategies implemented, especially compared with the no strategies and few strategies implementation, supports the possibility that the intensity of the intervention, in terms of the number of strategies and the length of time they were implemented may underpin the strong effect size.

A study of combat veterans with long-standing PTSD, different types of intervention, and long-term outcomes suggested that intensity of intervention be matched with the severity of PTSD symptoms. It may be that the intensity of the current intervention was appropriate, given the general severity of the baseline symptoms in the young children.

Aside from the question about the role of intensity in producing the outcomes, a practical strength of the strategies is that PTS symptoms can be reduced even in circumstances when partially implemented. ("low dose").

Positive focused, not deficit focused

Many interventions target particular children based on their symptomatic behaviour and focus on the deficits associated with PTSD. Alternatively, the present set of strategies, while

addressing the difficulties, does not focus on child deficits, but on changing the environment to one that promotes child health.

Acceptable to Schools

The intervention strategies are compatible with school aims and objectives, and curriculum, and are do-able. This strength means that schools are more likely to adopt and sustain the strategies, which has, as demonstrated, produced the strong effects as schools sustained use of the strategies over a relatively long period, as compared to other interventions (Zakszeski, Ventresco & Jaffe, 2017).

Do Not Rely on Clinicians

In comparison with other studies, these strategies do not rely on additional professional clinicians, counsellors, social workers, school nurses, psychologists or psychiatrists to support the schools during the first two years, which are always in short-supply and high-demand in post-disaster communities. Thus, the adoption of the strategies is initially easier and less expensive in terms of the cost of clinical staff. However, *Yes, I Can! Sparkle Coping* did use a specialist teacher to deliver the programme in the trial, and it is not clear that a teacher could deliver this programme.

Let Teachers Be Teachers and Parents Be Parents

Some intervention programmes focus on changing parent or teacher behaviour, in order to produce changed behaviour in the child (e.g., Incredible Years for Parents, Incredible Years for Teachers). Such interventions may inadvertently or by implication communicate that the parent or teacher is the underlying "cause" of the child's problems. For example, parents may infer that if they are being expected to change their behaviour to help their child, that the source of the child's problems must be in their (the parent's) original behaviour. Other strategies may mean that teachers must take on the role of mental health professionals, or that parents must become teachers.

By contrast, the present strategies confirm in the first year that the child's health is interacting with environmental structures (e.g., hanging decorations, the school schedule, need for omega 3), and this is provoking the child's ongoing difficulties which were caused by a physiological response to a repeated series of earthquakes during a sensitive period of brain development. The child's problems are not caused by parents or teachers. This affirms teachers as

professionals and parents as parents, where both have a responsibility to help the child gain their health through the provision of an environment which will help them 'get better'.

Psychoeducation helps teachers and parents understand the connection between the child's behaviour and how the child interprets the messages they receive from the teacher. It does not blame the teacher for the child's problems, but supports the teacher to respond effectively to stressed children.

The first two years of the strategies do not require teachers to engage in additional teaching activities. This makes the strategies more acceptable to teachers, who are typically under additional pressure themselves due to the effects of the disaster on their school, their own families, and their communities. Thus, teachers are able to focus on the mission of their profession and their school. By the time that sleep education is to be introduced, teachers implementing the strategies are less stressed due to the positive changes in their classrooms.

Inclusive and Culturally Acceptable

The innovative strategies are suitable for all children and do not require children to be withdrawn from their classrooms. Withdrawal programmes may mark children for bullying, or cause them to miss the normal school curriculum or after-school activities, and so may increase child stress responses. Teachers also can become stressed with scheduling responsibilities for withdrawal programmes.

As part of being inclusive, the strategies are acceptable to Māori and Pacific Island families, as well as to children from other cultural backgrounds, as far as studies show to date.

Require Few Additional Resources

The strategies are relatively inexpensive, due to not needing clinical staff. The largest expense is the provision of professional development at the start of each strategy step. Each school has their own Board of Trustees, which allocates funding, and schools receive some funding from the Ministry of Education for professional development in New Zealand, and manage their own budgets. These schools supported costs of professional development, which were the salaries of the attending teachers. Additional expenses are associated with strategies which may not be able to be provided by all parents, including water bottles, omega 3 capsules, the provision of high-carbohydrate morning snack, and it would fall on the schools to provide

these. Additional costs for printing would be associated with the use of the workbooks for sleep education.

Fidelity and Flexibility of Implementation

One of the difficulties in transferring interventions from research settings to applied settings has been difficulties with whether the intervention can be accurately implemented in the applied setting. In many situations, it seems that the effect of the intervention is weakened if the strategy implementation is not delivered at the same level as in the foundational research (Breitenstein et al., 2010).

In the present studies, strategies were implemented originally in the applied setting, as the necessity for addressing child concerns in the original study schools was paramount and there was not time for pilot testing in a controlled environment, which is a common approach to intervention development. Although there were some quality controls and independent observation of some aspects of implementation, there is only limited information about fidelity. Schools also adapted each strategy. For instance, Play-Eat-Learn timetables differed across schools, or were only implemented in the junior school. In another example, some schools provided water bottles while, in other schools, parents were asked to provide bottles. It may be that this flexibility of implementation, and schools' ability to tailor the intervention to their setting, contributed to the success of the strategies, but it also is a limitation in terms of understanding differential impacts across schools.

These characteristics of the intervention strategies may be associated with the larger effect sizes of this intervention, as compared with other interventions in earthquake-affected communities.

Strengths and Limitations of the Study Methods

All studies have strengths and limitations. In this section, the strengths of the study, and its limitations are considered.

Strengths of Study Methods

Mental health baseline

One of the strengths of the combined studies is the availability of directly comparable data on the mental health of children pre-Earthquake. There is no similar study of young children which has a community measure from a controlled cohort study prior to the disaster. This

adds confidence to the finding that exposure to the thousands of earthquakes and the post-disaster stressors are the most likely explanation for the rise in rates of PTS symptoms as children start school.

Longitudinal Design

Many studies use cross-sectional designs to evaluate the effects of interventions. This is typically accomplished by comparing one group of children who received an intervention with another group who did not. Or, random sampling to identify both the pre- and post-intervention measurement groups. Statistical comparisons are made to demonstrate the similarities of the pre-group and the post-group in terms of demographic characteristics, such as gender, ethnicity, age, and so forth. However, the impacts of the intervention on particular children, or the characteristics of particular children who responded well, or failed to respond, to the intervention can't be studied. Meta-analyses of the effects of interventions have repeatedly recommended the need for a longitudinal design, in which the same children are followed throughout. The present study includes a longitudinal measure of the strategies in the original group, with the same children followed for three years, which is a strength and adds support to the study findings.

Replication

The evidence demonstrates these effects have been replicated, although to a lesser extent, as there was only one year of strategies in the replication group. As children experienced the earthquakes and the subsequent adverse events over many years, it is expected that more than one year will be required to reduce the negative impacts.

Challenges in implementation are part of a school-based prevention programme (Domitrovich, et al., 2008) and effective programmes must be able to retain their impact when implemented in different contexts, so the replication study provides very strong evidence in support of strategy effectiveness, as it was implemented across so many different schools, kindergartens and preschools.

Statistical Evidence

Statistical tests are designed to give support to the effect of strategies, by providing evidence that recorded changes are above the probability level of chance. Statistical evidence has been provided throughout this report, and changes have met the statistical requirements of probability at or above the 95% confidence level for all of the major findings.

In the present study, a longitudinal repeated measures design was used, so that the children measured at each time point were the same children throughout. As these are the same children followed from school entry through the end of 2018, effects can be analysed using paired t-tests, which compare each child's symptom score at the end of baseline with their score at the end of the project. Paired t-tests are more powerful than the unpaired- t-tests used in cross-sectional studies because variability attributed to individual differences is eliminated. Thus, the results of the paired t-test which showed a significant reduction in the PTS scores of clinical-level children at baseline are strong evidence that this group of children's symptoms reduced during the strategy implementation phase.

Study Retention

This study has very strong retention of 89.7%. A high retention rate for a longitudinal study has been identified as 80% or greater for studies of one year or more (Abshire, Dinglas, Cajita, Eakin, Needham, & Himmelfarb, 2017). The retention rate is particularly high, given the changes in housing in a post-earthquake city. For example, a longitudinal study of children post-Hurricane Katrina recruited 913 children at ages 3-5 years and followed them through three years of school. The researchers report that only 26% of the children provided data at two time points, and discuss the 'missingness' of data in a post-disaster community (Osofsky, Kronenberg, Bocknek, & Hansel, 2015). Goldman et al. (2015) studied the effects of an 8-12 session CBT-based intervention programme for youth with high mental health needs and reported that only 53% of youth completed the post-test measures (p. 368). Thus, the retention rate in the present study is a strength.

Therefore, there is increased confidence in the study results, due to the high retention rate.

Analysis of contributions of Support Services and Enrichment Activities

One strength of the study is the analysis of the support services, which demonstrate that such services did not improve outcomes for children with PTS symptoms. It is well-documented in the literature that services that traditionally served children with special learning and mental health needs are less effective with children who have experienced trauma (Walkley & Cox, 2013).

Analysis of the contribution of enrichment activities is also a strength, because published studies of interventions have not usually reported the effects of other services the children might be receiving alongside the intervention.

Potential Confounding Events

Due to the absence of a method of quantifying fidelity of implementation, and because strategies were adapted in each school, and due to a lack of typical experimental controls for quasi-experimental designs used in natural experiments (Barnighausen et al, 2017), there exists the possibility that the results obtained may be due to other factors, such as, perhaps, changes in teaching, curriculum, and teaching staff within the participating organisations. However, the longitudinal design, the random selection of participants in the replication study, and the consistency of results across different schools argues against this possibility.

Limitations of Study Methods

Strategy Conceptualisation and Identification

The initial approach to intervention design was based on conceptualising children's PTS symptoms as predominantly a health problem and the initial plan to identify strategies was to scour the international literature to identify interventions with a strong evidence base. This is in contrast to the majority of interventions, which emphasise the psychological and cognitive foundations of PTSD. The strong evidence-base in the literature, include more than 260 meta-analyses (Hoffman et al., 2012), strongly suggests that providing cognitive behaviour therapy to children who have been affected by trauma may have produced better outcomes.

However, at the time, there were insufficient mental health resources to deliver CBT to children. Therefore, with the support of the principals of the original schools, the decision was taken to develop intervention strategies within the school setting that could reach all of the children in the school.

The initial plan to identify interventions was found to be impossible because school-based interventions with a suitable evidence-base for addressing the neurophysiological basis of symptoms, such as a high prevalence of child headaches, or children with arousal problems were not able to be identified. The predominant interventions were based on the use of strategies with a cognitive or psychological basis, and the research indicated that these strategies were unlikely to be as effective as CBT, which had already been rejected due to lack of resources to provide individual or small group CBT to the large number of children with high symptom levels.

Therefore, the second level approach was to identify strategies that addressed the child's presumed health problems. For example, it was presumed that the children were dehydrated based on measures of NZ children's hydration and studies of dehydration related to stress and PTSD; and also due to studies that related dehydration to behaviour and learning problems similar to those in the study children. From this presumption, studies that demonstrated the effect of having children drink more water were used as a basis for one of the intervention strategies. This line of reasoning and approach was repeated for all of the strategies. Thus, the link between the evidence and the intervention package is not otherwise supported, and thus the conceptualisation and design of the intervention may be conceptually limited. An intervention with a stronger basis in the literature, or with a different conceptual basis (e.g., providing a teacher-delivered psychologically-based programme designed specifically for children following a natural disaster across the school) may have provided better outcomes.

Methodological Limitations

The results are limited by many difficulties in methodology, resulting from many difficulties that occur in conducting applied research in a disaster-struck city. While the pre-EQ study had many experimental controls, the initial strategy study was lacking such controls. Some of the major limitations are considered below.

Limitations in Participant Recruitment. One major issue affecting studies is the issue of the nature of the study sample. One aspect of this is how participants are recruited. The recruitment rate of the pre-EQ cohort study was much higher than the recruitment rate in the initial EQ-Exposed children's pre-strategy study. Thus, because more than 90% of children entering randomly selected schools were successfully recruited in the pre-EQ study, the quality of the sample is high. Although recruitment difficulties are common in post-disaster studies and may be a result of many different issues affecting parental decisions regarding consenting to participate, the lower recruitment rate still affects the quality of the study. The replication study may be said to have a stronger methodology in terms of random selection of participants, but these were recruited without information on their earthquake exposure, so whether the participants' symptoms were related to the earthquakes, the post-disaster environment, or other stressors are unknown.

Implications of Decile Distributions. The small proportions of children attending low decile schools in the replication study (Study 4) limit the generalisation of findings in this report. The limitation affects the rate of PTS in the school population and the proportion of children with

clinical levels of PTS, which might be under-estimated. This is because, according to risk factors, it would be predicted that children from low-decile schools would have higher rates as compared to children from mid- and high decile schools, as these children would experience additional ACES associated with poverty and high deprivation neighbourhoods

Limitations in Intervention Implementation. Other differences, such as between the schools that adopted the strategies and those that did not, are also very important. For example, in the original study, the school that did not implement the strategies was a high decile school, and in the replication study, the schools that did not implement strategies were high and low decile schools. All of the mid-decile schools in the sample chose to implement strategies. In a controlled experiment, schools would be randomly assigned to implement strategies and this process would provide a more robust comparison.

Also contributing to difficulties in comparing implementers vs. non-implementors, there were no independent measures of implementation. Implementation was reported by support personnel and teachers, rather than being independently assessed. Principal interviews mid-way through the replication process, for example, did identify some inconsistencies in implementation reports. It is clear in the information from principals and teachers, as discussed in the Methods section and in previous reports, that strategies were adjusted and adapted in each school.

In controlled experiments, it is essential that interventions be implemented as precisely as possible, in order to increase confidence that the results can confidently be attributed to the intervention. Thus, professional oversight and independent measures of fidelity are included in studies with stronger methodology than the present study.

Limitations of Measures. The evidence for the changes in the present study are based on observable behaviours, not on neurophysiological measures, even though the strategies were hypothesised to affect neurophysiological factors. Thus, the measures are very limited in showing a direct relationship between the strategies and behavioural changes.

Another important limitation is the measure of PTS symptoms. The use of teacher and parent reports of behaviours linked to PTS symptoms, while again common in post-disaster studies, is less reliable than using child psychiatrists trained in child PTSD symptoms.

The supplementation of behavioural reports by in-person interviews, independent observation, and neurophysiological measures would have strengthened the study.

Cautions

Many Children Still Have Very Serious PTSD symptoms

Research into PTS symptoms emphasises that even one symptom can have serious functional impacts. At the end of the replication study, and after one year of strategies, the number of children with zero symptoms had improved to 38%, but this means that more than 60% of the children had persistent symptoms. After three years of the strategies in the original schools, 48% of children had zero symptoms, but that leaves more than 50% with one or more symptoms. Even one symptom can have an adverse impact of quality of life.

In addition, the increase in two schools of new cases of children who originally had few symptoms further indicates that children with low symptom counts in the present study are vulnerable to serious effects if they experience another school-related traumatic event. (The children in these schools had not received the *Yes, I Can!* Sparkle Coping programme.)

Schools' Over-Use of Stand-downs

Another limitation is that Christchurch schools continue to have high and increasing rates of age-adjusted stand-downs according to the Ministry of Education statistics released in July 2019 (Chapter 2) despite many implementing MOE programmes to reduce stand-downs, suspensions and expulsions (South Island Alliance, 2014). Principals and Boards of Trustees are frequently using stand-downs in an attempt to reduce problem behaviours in Canterbury primary schools. However, the fact that the trends are increasing, not decreasing, is evidence that the strategies are not effective. They may even be increasing the fear and anxiety within the schools and negatively impacting on school climate. Similarly, kindergartens and preschools use informal procedures to transition younger children with behavioural issues out of their centres. However, evidence indicates that stand-downs do not improve child behaviour in children with PTS, and many contribute to worsening their symptoms by exacerbating their fear and confirming their negative self-attributions. Additional research and support is needed to help principals and Boards of Trustees reduce stand-downs and find more effective ways to support children and establish calm learning environments.

Implications and Conclusion

Children Starting School in 2019-2021

Wishful thinking is a common negative coping strategy and many teachers and principals have expressed a wish that things could go back to the way they were pre-EQ. Sadly, that is unlikely to happen, as illustrated by the rates of clinical PTS in children from the replication study (Table 16; Reported in November and December, 2018). Rates of PTS increase over time as children get older, as they encounter new adverse events, with rates at every age level already greater than 15%. If preschools and kindergartens adopt and maintain the use of strategies over the coming years, rates may fall in those groups of children who experience the strategies. However, as only a minority of the children attend schools which implement the strategies, it is likely that the high proportion of children with 6 or more PTS symptoms shown in Table 16 will continue into the future. Irritability has been identified as a biomarker of mental distress and a direct predictor of adolescent suicide (Orri, et al., 2019). As children with high PTS are more likely to experience adverse events (e.g., school suspension) as a result of their symptoms, their symptoms are also likely to increase in magnitude and severity over time.

Table 16 Rates of clinical PTS and irritability by age and year in school in 2018 in non-strategy settings.

Birth Year	Age	Year in School 2018	% Clinical PTS*	% Irritable
2006	12	8	22.9%	21.4%
2007	11	7	22.8	23.9
2008	10	6	24.1	26.2
2009	9	5	23.0	24.6
2010	8	4	20.3	16.9
2011	7	3	24.8	21.6
2012	6	2	21.7	24.8
2013	5	NE/1 Year Start School	16.0	19.2
2014	4	2019	15.4	30.8
2015	3	2020	14.0	18.0
2016	2	2021	21.4	35.7

It is a myth that young children are biologically resilient to earthquakes and natural disasters. They are biologically vulnerable, as is evidenced not only by research, but by our community's

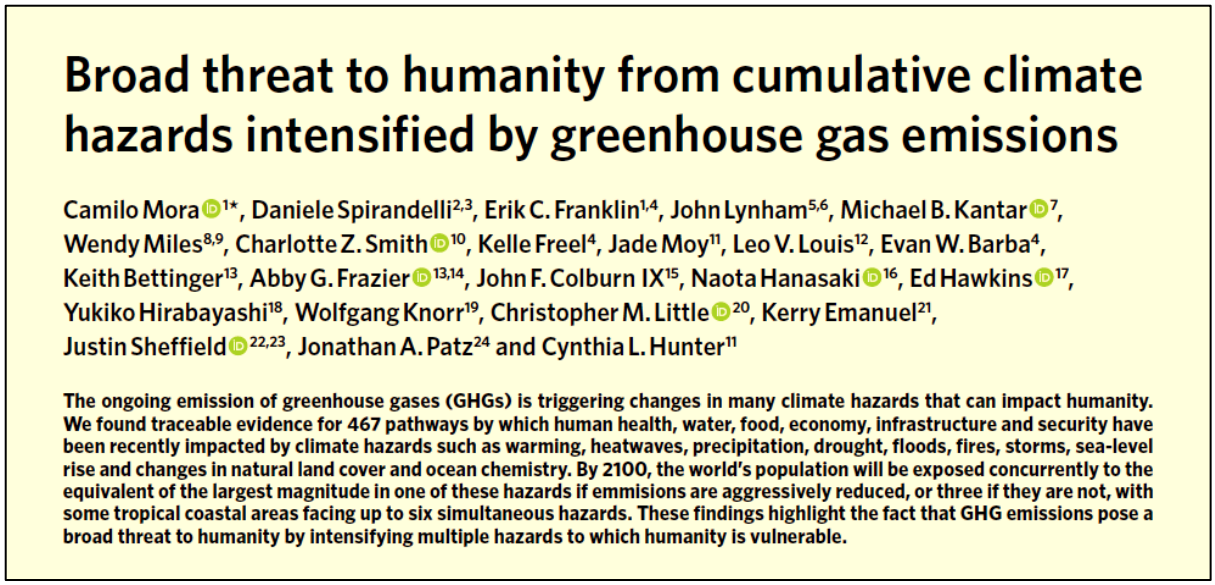
rising mental health referrals and suicide rate which are visible to all. Resilience has to come from appropriate support and longitudinal scaffolding of positive coping skills. Once we accept that our community is irrevocably changed, we can begin together to problem solve long term positive changes that can strengthen the next generation's resilience.

Potential Application of Strategies

The strategies may be helpful for children who have experienced other types of adverse events and developed similar symptoms. For example, Mackey and colleagues in The Imagen Consortium (2017) have identified that similar regions of the brain are implicated in the antisocial behaviour of young people and that young people who engage in antisocial behaviour are highly likely to have suffered adverse events in early childhood. Aghajani and colleagues (2017) have recently reported that young offenders who seem callous and unemotional also have experienced adverse childhood events, and have dysregulated brain function in similar brain regions, affecting their ability to understand important aspects of their environment and to learn. These studies point to the potential similarities with study participants, and suggest that the strategies may be worthwhile trialling with aggressive and antisocial youth.

Recently Camilo Mora of the University of Hawaii and 23 co-authors from around the world published an analysis of more than 3,000 research studies and concluded that multiple natural disasters— extreme heatwaves, wildfires, sea level rise, hurricanes, flooding, drought and shortages of clean water-- are predicted to occur simultaneously as the climate changes (Mora et al, 2018; Figure 47). For instance, California simultaneously suffered wildfires, drought, extreme heatwaves and dangerous levels of air pollution at the end of 2018. Mora and colleagues predict this confluence of disasters will occur more often.

According to the article, traditional research into one cause of PTSD – such as earthquakes— "can miss the bigger picture of the interrelation of disasters and the magnification of risk." Professor Mora and colleagues estimate that climate-related disasters will increase PTSD FOUR times what it is now.



Broad threat to humanity from cumulative climate hazards intensified by greenhouse gas emissions

Camilo Mora[1*], Daniele Spirandelli[2,3], Erik C. Franklin[1,4], John Lynham[5,6], Michael B. Kantar[7], Wendy Miles[8,9], Charlotte Z. Smith[10], Kelle Freel[4], Jade Moy[11], Leo V. Louis[12], Evan W. Barba[4], Keith Bettinger[13], Abby G. Frazier[13,14], John F. Colburn IX[15], Naota Hanasaki[16], Ed Hawkins[17], Yukiko Hirabayashi[18], Wolfgang Knorr[19], Christopher M. Little[20], Kerry Emanuel[21], Justin Sheffield[22,23], Jonathan A. Patz[24] and Cynthia L. Hunter[11]

The ongoing emission of greenhouse gases (GHGs) is triggering changes in many climate hazards that can impact humanity. We found traceable evidence for 467 pathways by which human health, water, food, economy, infrastructure and security have been recently impacted by climate hazards such as warming, heatwaves, precipitation, drought, floods, fires, storms, sea-level rise and changes in natural land cover and ocean chemistry. By 2100, the world's population will be exposed concurrently to the equivalent of the largest magnitude in one of these hazards if emmisions are aggressively reduced, or three if they are not, with some tropical coastal areas facing up to six simultaneous hazards. These findings highlight the fact that GHG emissions pose a broad threat to humanity by intensifying multiple hazards to which humanity is vulnerable.

Figure 46 Multiple disasters posited to threaten humankind.

Mora, C., Spirandelli, D., Franklin, E. C., Lynham, J., Kantar, M. B., Miles, W., ... & Barba, E. W. (2018). Broad threat to humanity from cumulative climate hazards intensified by greenhouse gas emissions. *Nature Climate Change*, *8*(12), 1062. Freely available: https://www.fs.fed.us/psw/publications/frazier/psw_2018_frazier003_mora.pdf

Communities with high rates of PTSD and other mental health problems will not be resilient to predicted natural disasters or their after-effects, such as suicide, substance abuse, and domestic violence.

Children with existing PTS symptoms are significantly more vulnerable to potentially stressful triggers in school and community environments. Thus, schools have the potential to be a resource for resilience (Boden et al, 2012) by reducing the stressful triggers in the school environments. When school environments establish appropriate environments, children's posttraumatic stress-is reduced.

Conclusions

The innovative combination of evidence-informed strategies to address the biological symptoms of PTS in the schools attended by children who had experienced a very extended period of earthquakes, floods, and other disaster-related events has produced strong positive results. These strategies do not rely on professional clinicians, and do not required teachers to engage in additional teaching activities until the third year. The innovative strategies are suitable to all children in preschool, kindergarten and primary school settings, and require few

additional resources. All of these considerations are especially important in a community struck by disaster, with limited mental-health resources and clinicians.

The results indicate that the strategies can have their best effect if implemented over time, substantially reducing children with clinical-level with a large effect size. Meanwhile, high rates continue unabated in the contrast schools. Children showed related improvements in self-regulation, attitude to learning and meeting achievement standards, while children attending contrast schools do not show improvements. Children in kindergartens and preschools similarly benefited from strategies.

The *Yes, I Can*! Sleep Education and Sparkle Coping Programmes provide substantial additional benefits to symptom reduction, and their implementation in all of the original and replication schools is likely to further improve outcomes.

However, unless schools receive priority support to continue with the Step 3 strategies, the results from the contrast schools suggest children's symptoms will increase as they unavoidably experience additional stressors.

Children with persistent PTSD symptoms are more likely to develop substance abuse disorders and attempt suicide in adolescence, and the adolescence of these children is on the very near horizon.

This future means children will need to have self-regulation, resilience, problem solving and positive coping skills as well as a positive attitude to learning. Schools can implement these strategies to assist them in preparing for their futures.

The results of this natural experiment suggest a role for physical and environmental characteristics of schools, in conjunction with dietary supplementation for some children, that affect stressed children in schools independent of various common explanations for child behaviour problems, such as socio-economic status of the children's families. As schools are part of complex systems contributing to mental health and wellbeing, future research should include the possibility that factors of the school environment, such as physical characteristics of classrooms, the daily schedule, and the availability of water and food contribute to child mental health, school behaviour and learning.

We want to prioritise reducing PTSD symptoms because these are serious, the strategies are effective, the risk of future mental health problems and suicide is high if the symptoms are not treated, and the treatment is cheap and low risk.

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Appendices

1. Additional Details of Study 3 Participants
2. Additional Information and Impacts of Individual Strategies.
3. Contributions of Support Services and Enrichment Activitits
5. Results for Individual Schools
6. Related Student Research

APPENDIX 1: DETAILS OF STRATEGY STUDY 3 PARTICIPANTS

Children begin school on their fifth birthday or on the nearest subsequent school day. Thus, schools experience cumulative enrolments. Children are progressed from the new entrant status to year 1 according to processes at individual schools. Similarly, progression each year is also a subjective process driven by individualised decisions in each school. Although children are assigned to a year level, schools commonly have classrooms of mixed year levels (e.g., Year 2/3) and also create different groups for reading and maths instruction, and other activities.

Recruitment into the longitudinal study (Study 2) concluded with Term 4 of 2015. Using data from 2015 as a baseline, the Strategies Study (Study 3) began with the implementation of strategies in Term 2, 2016. The baseline for the evaluation of the strategies was the measure taken at the end of 2015.

Table 17 Participant retention from Study 2 to Study 3.

Year Starting School	Before Strategies E 2015	Step One Strategies	*Step One Retention E 2016*	Step Two Strategies	*Step Two Retention E 2017*	Step Three	*Step 3 Retention E 2018*	3 (4) year Strategy Retention
	2015[a]	2016		2017		2018		2016-2018 (2015-2018)
	N	N	*%*	N	*%*	N	*%*	
2013*	64	50	*78%*	47	*94%*	48	*100.*	*98.0% (76.5%)*
2014	90	88	*97.7%*	80	*91%*	78	*97.5%*	*92.1% (90%)*
2015	69	66	*95.6%*	62	*93.9%*	56	*90.3%*	*84.9% (85.5%)*
Total	223	204	*91.5%*	189	*92.6%*	183	*96.3%*	*89.7% (82.1%)*

[a] End of year, Term 4 measures
* Some children recruited into the study in 2013 were new entrants (N=6) who had started school in the later part of 2012.
**Data was also gathered from 10 children who had moved from a study school to a non-study school in 2018
. Child returned to same school

Data to evaluate the strategies were collected on children who continued attending the study schools, and who were here during the earthquakes. The 82.1% retention across the strategy study years is shown in Table 17. The range across schools was 68.6% to 90%.

There are many possible reasons why children may leave a particular school. These include family-related decisions (e.g., parents move to another part of the city) and school-related decisions (e.g., school stands-down, suspends, or excludes a student). If disproportionately more children with high PTS leave, the results can be affected, as the overall mean may be reduced simply by these children leaving (see Liberty, 2017 for further discussion). In the present study, 14 moved before the strategies started, and five of these had high symptom levels. Of the children who moved during the strategies, 15 moved after the first strategy year and two of these had clinical-level of PTS. Thirteen moved after the second strategy year, and three of those had high scores. To control for the effects of moved children, the analysis presented in this report only considers retained children from baseline to the end of the project.

Year Levels of Participants

Table 18 Ages and school year level participant in Study 3.

2017 N (2018 N)	Year in School at Step Two Evaluation	Year in School at Step Three Evaluation	Years of Age at 22.2.11 Earthquake	Years of Age at End 2017	Years of Age at End 2018
			Mean (SD)	Mean (SD)	Mean
18 (16)	Year 2	Year 3	0.56 (0.21)	6.76 (1.67)	8.4
87 (83)	Year 3	Year 4	1.27 (0.31)	7.97 (0.66)	9.1
60 (56)	Year 4	Year 5	2.10 (0.33)	8.86 (0.33)	9.9
24 (27)	Year 5	Year 6	2.98 (0.20)	9.74 (0.20)	10.7
189 (182)*	Total		1.68 (0.75)	8.36 (1.06)	9.5

At the end of 2017, when the Step Two strategy implementation was evaluated, study children were in years 2-5 (Table 18). No children were in Year 1 or Year 6. A year later, study participants were in years 3-6.

Between 2017 and 2018, 10 children left project schools (189 to 179), and scores are missing for 2 of the children. Additionally, 5 children who were not evaluated at the end of 2017 were

evaluated at the end of 2018, giving a total of 182. (Plus 10 more children followed-up at other schools).

Gender

The proportion of boys (51.8% v. 53%) and girls (48.2% v. 47%) has changed slightly between baseline and the end of the strategies, but this difference is not statistically significant (Chi-square =0 .058, p=0.81).

Priority Ethnicity

The proportion of participants who are European increased from baseline (76.3% v. 79.1%), while the proportion of Maori has declined (17.4% v. 14.8), as has the proportion of Pacific Island (2.2% v. 1.8%) while the proportion of Asian (2.2% v. 2.7%) and Other Ethnicities have increased (1.6% v. 1.8%). This change is likely associated with changes associated with housing and housing costs on the east side of Christchurch since 2015. However, using the New Zealand government definition of Priority Ethnicity, statistical analysis shows no statistically significant differences between the proportion of Priority Ethnicity at baseline and the end of the project (Chi-Square= 0.649, p=0.41).

Deprivation Level

The proportion of participants from high deprivation levels has decreased slightly (34.1% v. 32%) as well as the proportion from mid-deprivation neighbourhoods (39.5% to 38.1%), while the proportion from low deprivation neighbourhoods has increased (26.5 to 29.8%) Using a comparison of high deprivation vs. all else -- since high deprivation is associated with a greater risk of mental health problems – a statistical test did determine that there was no statistically significant difference between the baseline and final strategy retained participants in terms of neighbourhood deprivation level (Chi-Square= 0.187, p=0.67).

School Decile

At the strategies baseline, 23.3 % of participants were attending low decile schools, 46.6% mid-decile schools, and 31.8% high decile. By the end of the project, there were 19% in low decile, 45.1% in mid decile and 35.1% in high decile. Proportionately more children moved from low decile school/s, and proportionately fewer moved from high decile school/s. This is the general pattern reported by the Ministry of Education. Children attending low decile schools are more likely to live in rented or shared accommodation, and, post-earthquake, the rent

increases and the rebuilding or destruction of homes in the neighbourhood of the low decile school are likely to have contributed to more children leaving from this school.

However, as explained above, there were not significantly fewer children from high deprivation neighbourhoods in the retained participants. Examination of the data indicates that 48.3% of retained children from high deprivation neighbourhoods were attending mid and high decile study schools.

APPENDIX 2: ADDITIONAL INFORMATION AND IMPACTS OF INDIVIDUAL STRATEGIES

Effects of Step One Strategies

A detailed difference in the impact of the first year of the strategies in the original implementation has been previously reported (Liberty, 2017), and is briefly summarised here. Detailed descriptions of changes in the replication stud over one year are included in the main body of the report.

Post-traumatic Stress Symptoms. In the first year of the strategies, the mean PTS score in the three schools that implemented the majority of strategies fell significantly from 2.97 (SD=2.98) to 2.04 (2.69; paired t-test =3.607, p>.000). The overall changes can be seen in the progression of changes from baseline to the first strategy year in Chapter 6.

Achievement. In the first year of the strategies for the three schools implementing them, there was an improvement in children meeting the national standard in reading (66.7% to 72.8%), writing (62.3% to 66.7%) and maths (65.8% to 77.6%).

Continuation of Step One Strategies

The overall percentage of implementation fell from 77.8% of strategies (N=14 strategies) in the first year to 37.5% of strategies, including RIRO (N=13) in the second year. The strategy that was least likely to be continued was the use of children's water bottles in the classroom. Failure to continue strategy implementation was also associated with teachers' professional development. Teachers in the senior year levels were more likely to be new to the school and/or were teachers who had missed the professional development sessions about the project. In addition, new teachers were more likely to have children with high PTS symptom scores

placed in their classes at the start of 2017. Another factor was the increased expectations for behaviour and learning of year 5 teachers.

Evaluation of the strategy implementation in the final project year was influenced by the overall project plan, in which strategies were implemented in a step-wise fashion. For example, it was not planned that all strategies implemented in year one/step one would need to be continued into year three, because it had been hypothesised that the rooms would be calmer and that schools would continue to implement the strategies from the first two years that had been effective. For example, some teachers found that the removal of hanging decorations had been effective in the first year. However, during the second year, although it was recommended that step one strategies be continued, hanging decorations had been reintroduced in some classrooms. Also, one school did not implement all of the step one strategies until the second year.

In the third project year, principals tended to let individual teachers make decisions regarding the calm down strategies. In addition, one school's total earthquake re-build had been completed during the second project year, and the overall colour scheme of this school followed project recommendations regarding a calm environment. In another school, the step two strategies were not introduced until the third project year, as the introduction of strategies in this school had been consistently delayed due to events during the first project year (Liberty, 2017a). The calm down the classroom, Play-Eat-Learn, and Drink to Think strategies were implemented in different ways in some rooms of the original project schools during the third project year.

Calm Down Classroom Environment. In 2018, teachers were asked whether or not they implemented the Calm Down Classroom strategies (yes, partial, no, unsure), introduced in the first project year. Overall, 67% of children were in classrooms that used the calm down strategies (range across schools, 13% - 82%). The calm-down strategies tended to be implemented consistently in the junior school, and less often in the senior school. However, these did not include the wall colours or noise recommendations.

Drink to Think, Think to Drink. The Drink to Think strategy included procedures to ensure that each child had a water bottle in their classroom or hub. The children were taught to "take a drink" when they were upset, feeling down, feeling tired, etc. This was the first coping strategy taught to children and was introduced in year one/step one. Teachers were instructed that the children were to be allowed to take a drink whenever they (the children) wanted, and to not use the water bottle as part of a behaviour modification programme, reward programme,

and so forth. If a child destroyed or lost their bottle, this was to be replaced – the child did not have to earn a new water bottle and was not to have punishment associated with drinking water.

During the second project year, many of the original strategy schools had a large turn-over in teachers, and there was evidence presented to the schools by the project that indicated that new teachers had not been trained in the Drink to Think programme, and that implementation was inconsistent.

During the final project year, teachers reported whether or not each study child had a water bottle (yes, no, unsure). Almost all of the children in the original study schools (83%) had a water bottle, and one school repeated the Drink to Think training for children and teachers. Children who had a water bottle had slightly improved PTS scores compared to the end of 2017 (mean of 2.57 to a mean of 2.42), while those who did not have a water bottle had slightly worse scores (mean of 2.62 to mean of 3.28), but this was not a significant difference (PTS Score End 2018, F=2.001, p=.16).

In the replication schools, 78% of the children had a water bottle (range across schools, 46%-94%) and 16% did not (range across schools, 5-33%), while teachers were unsure about 6% of the children (range across schools, 0-21%). However, this strategy may have been affected by the chlorination of the water supply and the change in the taste of the water, as schools were not able to provide filtered water for the children and staff (as described in Chapter 2).

Play-Eat-Learn Schedule. Similarly, during the third project year, schools had adapted to either a full or a partial Play-Eat-Learn schedule, depending on individual school decision making, and no further changes were part of any strategy plan for the final year. In some schools, part of the school (e.g., the junior classes) might be using a Play-Eat-Learn schedule while the other part of the school (e.g., the senior classes) were not.

During the final project report, teachers were asked about the use of the Play-Eat Learn Schedule (yes, partial, no, unsure). All study children were in classrooms that followed the full day Play-Eat-Learn schedule (range across schools (62%-100%) or the partial schedule (range across schools 0-38%). Children who experienced the partial schedule were, on average, more likely to be in years 4 and 5.

All children in strategy schools experienced PEL at some point. All study children in years 3 and below experienced the full day structured using PEL, and all but two were in classrooms using calm down strategies. As study children moved into the senior school, strategy implementation changed, along with teacher expectations for learning – as reported, children's

learning had improved following the second year of strategies. Therefore, during the third project year, in the senior year levels 4 and above, most children (81%) experienced a partial PEL schedule, usually the morning through lunch, but not used in the afternoons. Comparing a partial PEL schedule with a full PEL schedule in the senior school, there were no significant differences in PTS symptoms or behaviour problem scores (BPI Score End 2017 (N=161) F=0.114, p=.74; BPI Score End 2018 (N=166), F=0.44, p=.51: PTS Score End 2017 (N=161), F= 0.063, p=.80; PTS Score End 2018 (N=166), F = 0.009, p=.92.Ns differ as children enter the senior school or move from a full to a partial schedule). Most children in the senior school (65%) also experienced calm down strategies. Teachers who had children with higher levels of PTS at the end of 2017 assigned to their classroom for 2018 were more likely to use the calm down strategies in 2018. There were no significant differences PTS symptoms or behaviour issues in the rooms associated with the use of calm down strategies in the senior school (BPI Score End 2017 (N=161) F=0.607, p=.44; BPI Score End 2018 (N=166), F=0.977, p=.32; PTS Score End 2017 (N=161), F= 0.527, p=.47; PTS Score End 2018 (N=166), F = 1.949, p=.17; Ns differ as children enter the senior school or move from a rooms using calm down strategies to those not).

Effects of Reaching IN . . . Reaching OUT

During the second project year, RIRO was the principle new strategy for three of the original strategy schools. One school implemented RIRO in the third project year. According to the RIRO evaluation, teachers were very positive about the strategies. Project data showed improvements in teacher expectations and child achievement during this strategy step.

RIRO may be evaluated by looking at Teacher Expectations for learning, which is an early indicator of teacher-pupil relationships, as a more positive relationship would be associated with a more positive expectation for learning. If teacher expectations for children's learning and behaviour are positive at the beginning of the school year, the research literature indicates that children's achievement and learning is likely to be higher, as compared with classrooms in which teachers have low expectations of children's behaviour and learning (Brault, Janosz & Archambault, 2014; Rubie-Davies, Hattie, & Hamilton, 2010; Sudkamp, Kaiser & Moller, 2012).

The results show an important difference during the project, with teacher expectations for children in the RIRO implementing original schools increasing at the start of the second project year, followed by more children improving to pass the national standards during the

second project year, as compared to children improving during the first project year (see main text). RIRO and Step One strategies were implemented by replication schools, preschools and kindergartens. The changes in the replication sites reflect the impact of these strategies, when compared to the lack of improvements in the non-replication sites (e.g., see Chapter 6).

Achievement results during the final project year are compounded by the change from national standards to local school standards. However, overall, RIRO contributed to significant positive changes for children's learning. Due to the nature of the applied research, it is not possible to statistically separate the effects of RIRO from the effects of the other strategies that were implemented during this time.

Effects of *Yes, I Can! Sleep Inquiry & Sleep Scientist.*

The Sleep Education programme (B. Liberty, 2018a) was designed to be implemented by teachers of children in years 4 and above.

All four of the original strategy schools chose to implement the sleep education programme, two in Term 1 and two in Term 2. The initial trial (conducted in term 4 of 2017) identified that some children in Year 4 might struggle with the programme, so it was left up to the individual school and teacher to determine if children in year 4 would participate. In addition, one school decided to trial a simplified version in years 1-3. The Sleep Education programme was also delivered in one replication school which had completed one year of strategy implementation.

Effects of sleep education on sleep, memory and recognition of facial expressions

A master's thesis research study evaluation of changes in sleep and cognition associated with the sleep education programme was conducted during Terms 2 and 3 (Gu, 2019a). This study involved 10 pupils with self- and parent-reported sleep problems in one of the original strategy schools (School A) and 10 pupils in a replication study school (School B) (Gu, 2019a). Some of the data collected for the thesis research, and additional data from the replication study are reported in this section.

A master's research thesis examined the effects of the sleep education programme (Gu, 2019a). Four principal measures were used: child-report sleep diaries, a standardised sleep measure, tests of short-term working memory and tests of facial emotion recognition.

Sleep diaries are a common measure of sleep that uses self-report. The children kept a sleep diary for seven days before the sleep education programme and then for seven days after the

programme. The data for school nights was analysed for this report, because the sleep education programme emphasised daily functioning at school and during learning, and to avoid some problems on weekends (children sleeping at places that were not their primary residence, children staying up late to participate in family events, the change to day light savings time). The sleep diary used the format that is used in the Yes, I Can Sleep Scientist workbook and was retrieved by the researcher from the child at the end of each study phase. The sleep diary included information typically included in sleep diaries used in research studies (e.g., Hudson et al., 2009).

The sleep diary was used to provide information on child's bedtime and wake-up time, and sleep duration was calculated on these times. In addition, the child rated themselves on the difficulty of falling asleep, their general feeling on awakening (refreshed, drowsy or sleepy), and their general feeling during the day (amazing, good, ok, moody, grumpy).

The *Sleep Self-Report* (SSR) consists of 26 standard questions covering sleep (Owens, Maxim, with a three-point Likert scale to denote the frequency of specific behaviours (3 ="Usually; 5 to 7 times per week", 2 = "Sometimes; 2 to 4 times per week"; 1="Rarely; 0 to 1 times per week or never").

The tests of emotion facial recognition and working memory were administered on tablet using standardised software from The Cambridge Neuropsychological Test Automated Battery (CANTAB).

The researcher also noted if children completed the sleep education programme.

School A (Original Strategy School in Study 3). There were three children aged eight years, two children aged ten three children aged eleven and two children aged twelve. There were five girls and five boys.

The New Zealand Ministry of Health uses the Sleep Health Foundation's research-based guidelines for recommended hours of sleep, and the recommendation for children of primary school age is within the range of 9-11 hours (Sleep Health Foundation, 2019). Of the 10 children, three children were sleeping more than the recommended duration, two were sleeping less, and five were sleeping within the recommended duration range.

In this school, the thesis research indicated that 7 children completed the sleep education programme, with five reporting that they met their goal during the Sleep Scientist phase.

Overall, the children at this school improved on an average of 3 sleep variables, and also all improved on the working memory tests (Table 13). All but one also improved on emotional facial recognition. One of the older children improved only on one sleep variable around bedtime behaviour, which was related to her goal, and this child also improved on working memory but not facial recognition.

Of the three children who did not complete the programme, all were eight years old. All three completed the first workbook (Sleep Inquiry), but then were absent from school during the Sleep Scientist Phase, and did not complete the goal setting workbook. Two of these children completed the pre and post- measures for the study, and both of these children showed improved sleep duration and sleep behaviour, both showed improvements in working memory and emotion recognition. It is possible that these improvements are related to changes as a result of the Sleep Inquiry programme, but this cannot be demonstrated as the children did not participate in the goal-setting and self-directed sleep change phase of the programme.

Across all of School A, all children (years 3-8), received the sleep education programme during Term 2, including all study children. Across all of original strategy schools, all but 14 of the study children received the Sleep Education programme, and these included children who were two young for the original programme. Therefore, it is not possible to make comparisons between those who received the programmed and those who did not.

School B (Strategy Replication School in Study 4). There were two children aged eight years, three aged nine years, and five children aged ten from School B in the study. There were five girls and five boys. Of the 10 children, five children were sleeping more than the recommended duration and five were sleeping within the recommended duration range. Nine of the 10 children received the entire programme; one eight-year old failed to complete the second part.

Overall, the children at School B improved on an average of 3.8 sleep variables, and also all improved on the working memory and emotion recognition tests (Table 19).

Table 19 Effects of Yes, I Can! Sleep Education Programme in two groups.

Outcome Category	Outcome Variable	School A % (N)	School B % (N)	Overall
Programme Outcomes	Number completing	7	9	16
	Number of children meeting self-directed goal	71% (5)	89% (8)	81% (13)
Sleep Outcomes	*Child Sleep Diary*			
	Improved sleep duration[1]	53% (3/5)	75% (3/4)	67% (6/9)
	Earlier bedtime [1]	40% (2/5)	0% (0/4)	22% (2/9)
	More consistent bedtime	14% (1)	22% (2)	19% (3)
	Improved sleep quality at wake-up	43% (3)	75% (6/8)	60% (9/15)
	Improved daily functioning	57% (4)	89% (8)	75% (12)
	Child-Parent Sleep Report			
	Improved overall	43% (3)	44% (4)	50% (8)
	Improved bedtime	71% (5)	44% (4)	56% (9)
	Improved sleep behaviour	43% (3)	56% (5)	50% (8)
	Improved daytime sleepiness	14% (1)	22% (2)	19% (3)
Cognitive Outcomes	Working memory strategies	71% (5)	78% (7)	75% (12)
	Working memory accuracy	71% (5)	89% (8)	81% (13)
	Emotion Recognition speed	43% (3)	78% (7)	63% (10)
	Emotion recognition accuracy	71% (5)	67% (6)	69% (11)
	Accuracy of recognising specific emotions	71% (5)	100% (9)	88% (14)
Outcome Summary	Improved on at least one sleep variable	100% (7)	100% (9)	100% (16)
	Average number of improvements to sleep (range across children)	3.1 (1-6)	3.8 (2-7)	3.5 (1-7)
	Improved working memory	100% (7)	100% (9)	100% (16)
	Improved emotion recognition	86% (6)	100% (9)	84% (15)

[1] Excludes children sleeping longer than recommended duration range

Sleep education vs. control.

A separate evaluation was also conducted in School B, using children who were participants in Study 4. All study children in this replication school were assessed as usual for Study 4 before the start of Term 3 in which sleep education was implemented and at the end of Term 4, after sleep education was completed.

Across all of School B, the strategies were implemented in two hubs of children in years 4-6 in Term 3, including 28 of the randomly selected study children. However, Sleep Education was only implemented in one hub of year levels 4-6. A comparison was made between these two hubs.

Children participating in sleep education, showed decreased PTS symptoms and increased self-regulation scores, while the opposite occurred in children who did not receive sleep education (Table 20, Figure 47). The per cent of children meeting the reading standard in the sleep education group increased from 75% to 86%, while the non-sleep education rate was unchanged (54%).

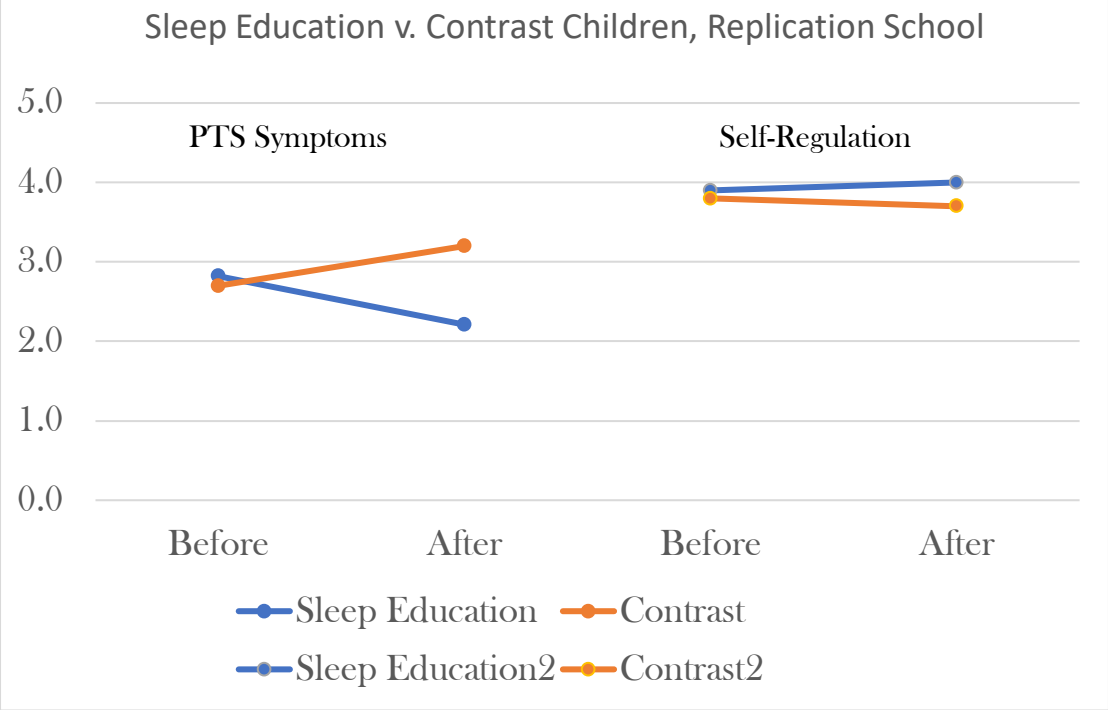

Figure 47 Effects of sleep education on PTS and self-regulation

Table 20 Impact of sleep education with strategies vs. strategies only on PTS symptoms.

Groups		Post-traumatic Stress Symptoms	
		Before	After
		Mean (SD)	Mean (SD)
Sleep Education with Strategies	N=28	2.82 (3.2)	2.21 (3.2)
Control, Strategies Only	N=54	2.70 (3.0)	3.20 (3.0)

Overall Effects.

The evidence indicates that the *Yes, I Can! Sleep Education* can improve children's sleep, working memory, facial emotion recognition, post-traumatic stress symptoms, self-regulation and learning when it is implemented following successful strategy implementation.

Effects of *Yes, I Can! Sparkle Under Pressure*

Britta Liberty

Yes, I Can! Sparkle Under Pressure (SUP) is a positive coping programme for children ages 9-13. It teaches children to recognise how their body responds to stress, and how stress can impact their health and relationships. It explores how other people can show signs of stress and encourages children to empathise and respond kindly towards people who are struggling to cope. Children explore strategies to calm down and problem-solve ways to reduce their stress.

SUP helps children to develop positive strategies to cope with stressors by arming them with skills for self-regulation. SUP uses self-determination learning theory and positive psychology to empower children to make positive changes in their life. It provides them with opportunities to set their own goals and be in control of the changes that they make.

SUP uses the creation of a diamond as a metaphor to help children explore how people may cope with daily stressors. For example, in the right combinations, all carbon atoms have the potential to form diamonds, just like every child has the potential to learn how to self-regulate.

Using the diamond metaphor, SUP identifies 'rough' strategies as any strategy that has no effect, or a negative effect, on the stressor. The Diamond Coping strategy is self-regulation, which the children learn to use to minimize ongoing stress and reduce future stress by applying

positive coping strategies such as cognitive reframing, seeking support, and so forth. Children are encouraged to recognise that they can take charge of their own coping strategies and they learn how to reduce their negative responses to stress.

SUP uses an empowering goal setting strategy to help children practice self-regulation and to make positive changes to their personal coping strategies. Each child is guided through the process of developing stress-reducing strategies to calm down and problem-solve. They are also encouraged to recognise stress in other people and understand steps that they can take to reduce stress in their classroom and in the wider school. SUP encourages children to develop positive coping strategies that they will be able to use for the rest of their lives.

Effects of Yes, I Can! Sparkle Under Pressure.

This programme was introduced in one of the original strategy schools and one of the replication schools.

Original strategy school. This school had two hubs that contained children in years 5 and 6, and one hub received the Positive Coping Programme, delivered by trained Resource Teachers of Learning and Behaviour (RTLB). The other Hub received a special class-wide programme from the RTLB to support behaviour and learning. A total of 65 children received the positive coping programme, split across Terms 3 and 4. The programme was delivered in larger groups than the recommended size, but all children were placed in groups such that all children received the same session in the same five-day period. Of the study children in this school in years 5 and 6, 65% received the positive coping programme and the others received the RTLB programme.

The mean PTS symptom score of the group that received the Positive Coping programme dropped from 4.83 to 2.27, which was the largest change across the original schools for the same age group (paired t-test = 2.175, p=.05). The mean PTS score of the group of children of the same year level in the same school who received the RTLB programme also dropped, from 4.41 to 3.00, but this change was not statistically significant. In terms of median scores, the non-Positive Coping group dropped from 3 to 1 PTS Symptoms; however, the median for the Positive Coping group fell from 5.0 to 0.0 symptoms. Thus, the Positive Coping programme, *Yes, I Can! Sparkle Under Pressure*, had a significant positive impact on study children who received it as part of their class health education curriculum.

Replication School. This school had a combined class of year 7 and year 8 children. The Positive Coping programme was delivered by two of the trained specialist RTLB who delivered

the programme in the original strategy school. All 12 of the year 8 children in Term 4 participated (2 groups). During the Sparkle programme, the Year 7 children remained in their classroom or followed their usual schedules.

Of the twelve children in Year 8 who received the Sparkle programme, four were in the random sample. In the same classroom were four Year 7 children who did not receive the coping programme. The four Year 8 pupils average PTS Score improved from 3.75 to 3.00, including one child whose score reduced from the clinical-level (i.e., from 9 to 4). However, of the four children who did not receive the programme who were Year 7 children—their PTS score average increased from 5.25 to 7.5, and the number of children at or above the clinical-level increased from 2 to 3.

Self-regulation average mean-item score of 3.35 maintained in the Year 8 children, but the Year 7 children's average mean score dropped from 3.6 to 2.7.

Overall, the evidence points to the potential of the positive coping programme to improve children's ability to self-regulate their responses to daily upsets, and this reduces their overall PTS symptom rate. Unfortunately, resourcing was not available to deliver this programme to all of the children during the final project year.

Effects of Nature Videos for Self-Directed Coping

With Clare Vesty (University of Canterbury), Helen Gillespie and Sarah Newcombe, both from the Department of Conservation—*Te Papa Atawhai*

The trial involved the following equipment.

Tablets. The only software on the tablets were the two DOC nature films. Tablets were set-up by a technician to include only the two icons on the home screen. One icon opened to video 1 when touched and the second opened video 2. Due to concerns that the blue light on devices can affect arousal levels, the tablets were set to a nighttime "warm light" setting. Tablets were not internet capable.

Videos. The videos were prepared by the Department of Conservation to show New Zealand content. Video 1 showed Snares Penguins on a rocky shore and was 17 minutes 15 seconds long. Video 2 showed dolphins swimming underwater in the Bay of Plenty, and was 17 minutes 16 seconds in length. Children used headphones when watching the videos.

Procedures. The first step was to educate the teacher about the background to trialing the nature videos. The was explained by the RTLB lead for the school. She explained to the

teacher who volunteered for the trial that there is evidence that long slow nature exposure will help children and adults calm down. As the children can't leave the school to take a walk, or take a walk away from the school grounds by themselves, watching nature videos could be an alternative. Research has shown that nature videos also help people in hospital wards and doctors waiting rooms feel calmer (reduce situational stress). The tablet is kept in the back of the room. The child determines when they need it and how long they watch it. If a child wants to watch it, the teacher must allow them (otherwise the child will not be self-regulating). If the teachers control access and/or give permission, then the child is only obeying or complying, they are not learning self-control.

Next, the trial procedures were explained to the teacher. These procedures directed that the tablets were to be kept in the back of the room. The teacher explains the tablet to the children with high stress. The child is shown the tablet, and told they can watch either video when they feel very upset, or need to calm down. Children should be able to watch the video to the end, and determine when they are ready to rejoin the class. The tablet is not to be used as a reward or taken away as a negative consequence, as this will reduce its efficacy in terms of self-determination.

Effects from Nature Videos Trial

A traditional classroom with *27* children in year 5 or 6 in a full primary low mid-decile school with 340 pupils was the site of the trial. The school had 41 children continuing in the Strategies Study, with an average age of 9.8 years. Of the 27 pupils, 11 were study children in the Strategies Study, including five boys and six girls, with an average age of 10.2 years. Four children who were nominated by the classroom teacher to participate in the pilot. The four children included three boys and one girl (child 2). The Trial Room had the highest concentration of high stress children in the school.

The trial used the same measures as used in the overall study. Anecdotal reports from the classroom teacher and teacher aide provide qualitative descriptive information relevant to the children's use of the tablet with the nature videos. According to teacher reports, the children used the tablet when upset and the children did recognise when they were upset and then obtain the tablet.

At the end of the trial period, the teacher asked the children what they thought about the tablet with the nature videos.

Child 1. This child used the tablet, and also taught another child (Child 3) how to use it. The teacher noted that the tablet was used following an incident during lunch with one of the children. On another day, that child said "If I had used the tablet, that would have been better, but I forgot it" (Said when discussing an earlier incident).

Child 1 said: "I think it [the tablet] works. When I put it on I feel myself calming down. I liked the dolphin one more. The sound of the dolphins helps but the movements of the penguins are nice, too."

Child 2 stated: "It's pretty good. When I put it on its just so calming which makes it really good. I find it easier when it is handed to me if I am really upset. I don't always know when I feel that I need it.

Child 3. "It's good. I like the one with the dolphins more. The sounds calm me down and I like dolphins. It's good for me when I need space and I am frustrated or annoyed. I haven't used the penguin one because I like things with sound better.

Child 4. A friend made him extremely annoyed and he got very angry. He tried the tablet for 5 minutes but thought a run might help him more. Did not use it again.

The tablets with the videos were liked and accepted by the teacher, and by three of the four children who were nominated to use them. However, two schools refused to trial the tablets, preferring to have teacher-control over their use. The overall context in which the tablets were trialled was one of high stress in the school. Almost half of the study children in the school showed increased PTS symptoms, due to a traumatic event in the school community. The fact that there were only two tablets available for use in only one classroom in the school limited the trial, as well as the lack of direct measures for all children.

Continuation of the trial, with additional tablets and in other schools with children suffering from high stress is recommended. Additional tablets are recommended. The type of sound track paired with the video can also be explored. It may be advisable to trial teacher-directed and child-directed use.

Yes, I Can! Be Kind

Yes, I Can! Be Kind (B. Liberty, 2018b) is very different to the sleep programme because it's short and mostly verbal. It is based on Positive Psychology Education and teaches children about Kindness. It explores being kind to the environment, to myself and to other people. This programme is aimed at younger children –for whom the Sleep Inquiry and Sleep Scientist

programmes are not suited--as an introduction to positive coping and self-regulation. There's no training required and very little preparation required for the teacher to deliver it.

Some key points about *Yes, I Can! Be Kind*:

- Based on positive psychology education
- Research shows if children learn about kindness their learning in other subject areas improves
- Session time of 20 minutes is similar to commonly used "circle time" in junior school classrooms
- Children are not asked to read or write during the programme.
- Only resources needed are a computer with internet access, a data projector or similar and audio capabilities
- Can be delivered by the class teacher to any sized group.

This school that was interested in trialling the programme determined that this was best introduced at the start of the next school year. Information about this trial is not available.

APPENDIX 3: CONTRIBUTIONS OF SUPPORT SERVICES AND ENRICHMENT ACTIVITIES

Children receiving Support Services

The Ministry of Education (e.g., Specialist Teachers), the Ministry of Health (e.g., Canterbury District Health Board Child and Adolescent Mental health Services), non-governmental organisations (e.g. the Neighbourhood Trust), and private providers (e.g., Kip McGrath) provided support to about 36.4% of study children in the original strategies school during the three years of the strategies project.

Clinical Group

Children, especially boys, from the baseline clinical PTS group were most likely to have received support. Significantly, none of the girls received support, and about 58% of the boys received support (Chi-square=10.694, df 1, p=.001). Boys from low SES neighbourhoods were significantly more likely to receive support (61.5%) as compared to boys from mid or high SES (27.3%), but there was no difference by ethnicity (SES: Chi-square= 7.028 df 2, p=.030. Priority ethnicity: Chi-square=1.270, df1, p=.260).

Table 21 Support services provided over three years to children in Study 3.

Support Service	Study Year		
	2016	2017	2018
RTLB	10.3%	7.9%	7.7%
Counsellor/ Psychologist	3.9	2.6	3.3
Social Worker	0	0	0
Other support	13.7	12.7	7.1
% receiving at least one support	24.5	16.9	17.6
% receiving two supports	3.4	3.2	0.5

Within the group that received support, 22% (N=14) received support from RTLB, 9.4% received support from a counsellor or psychologist, and 20.3% received support from other services (no support from a social worker was reported). Of children who received support, most received support for one year (Table 21).

Participation in Enrichment Activities

Kapa Haka was the most commonly accessed enrichment activity during each project year, with participation in music-related activities (e.g., learning a musical instrument, choir) following. Approximately half of all children participated in at least one enrichment activity each year, with an overall rate of 78% (Table 22).

Table 22 Study 3 children's participation in enrichment activities over three years.

Activities	Study Year		
	2016	2017	2018
% Sports	10.8%	6.9%	19.8%
% Musical Instrument	11.3	15.9	22.0
% Choir	7.4	10.6	17.0
% Kapa Haka	36.3	27.5	30.8
% Other	7.8	12.2	8.2
% Not participating	49.7	51.4	45.6
% Participating in one or more	50.4	48.6	54.4
% Participating in two	11.3	14.3	20.3
% Participating in three or more	5.9	5.3	9.9

Baseline Clinical Group

During the first project year, there was no statistically significant difference in the proportion of those in the clinical group (70%) participating in enrichment as compared to the children who did not have a clinical PTS at baseline. Within the clinical group, there were no differences in participation by gender during any year.

Within the clinical group, during the first project year, significantly more children from Low SES neighbourhoods (63.6%) were likely to participate in enrichment, as compared to mid (44%) and high (20%) SES neighbourhoods. But these rates changed during the second year (45.5%, 22.2% and 50%, respectively) and third year (36.4%, 33.3% and 70%, respectively). Overall, in the baseline clinical group, participation rates fell in low- and mid-SES groups and increased in the clinical group.

Within the clinical group, during the first project year, significantly more children of priority ethnicity participated in enrichment activities (75%) as compared to other ethnicity (22.2%, Chi-square=8.167, p=.004). But in the second project year, the participation rates were 33.3% and 44.4%, respectively, and 50% and 44.4% in the final project year. Thus, the participation of the baseline clinical children of priority ethnicity fell during the project, from 75% to 50%, while the participation of the other ethnicity increased from 22.2% to 44.4%, but overall, children of priority ethnicity participated at a higher rate in enrichment activities.

During the project, 79% of all of the children participated in enrichment activities, and there were no significant differences by gender, priority ethnicity, or neighbourhood SES in participation rates. Children from low decile schools (86.1%) and high decile schools (82.3%) were more likely to participate in enrichment activities than children attending mid-decile

schools (73.1%). Children in traditional classrooms were significantly more likely to participate in enrichment activities (86.3%) as compared to children in ILE (70.4%; Chi-square = 6.695, p=.010). Overall, 77.2% of those from low-SES neighbourhoods, 79.1% of those from mid-SES and 80.4% of those from high-SES neighbourhoods participated in enrichment activities.

Summary of Support and Enrichment

Table 23 Study 3 children's support services and enrichment activities

Activity	Participation Rate		Years Participating		
	Never	Ever	One year	Two Years	Three years
Support	63.6%	36.4%	18.8%	11.4%	6.3%
Enrichment	21.1%	78.9%	26.7%	29.5%	22.7%

Considering all of the children in the original schools, 36.4% received support, most for one year. Of all the children, 78.9% participated in enrichment activities, with almost 30% participating for two of the three years (Table 23).

Children Receiving Support and Participating in Enrichment. Of the continuing clinical children in the original schools, 16.7% received neither support or participated in enrichment, while 43.3% did both. Considering all of the participants, 11.9% participated in neither, and 27.3% participated in both.

As children also may have benefited from support services and participation in enrichment activities, the contributions of these services must be evaluated.

Contributions of Support Services

An initial analysis of the effects of support services does not show that these contributed improvements (Figure 49, Figure 50). Overall children with clinical PTS at baseline *who did not receive support* had significantly better improvements ($F=163.668$, $p<.001$), on average, in PTS symptoms, as compared to those who did receive support (although these were not different at baseline).

Of the clinical children who improved, about 33% received support and, in the group with continued clinical symptoms who did not improve, 11 of 12 received support. Those who

received support had significantly lower self-regulation and attitudes to learning scores at the end of the project as compared to those who did not receive support.[7]

Similarly, children with clinical scores at baseline who received support were significantly less likely to pass the national standards in writing (p=.008), while differences in reading (p=.07) and math (p=.93) did not reach statistical significance standards. Similar results were recoded for N=49 children who received support who did not have clinical PTS at baseline, with significantly fewer children who had received support meeting national standards in reading, writing and maths (all p<.001).

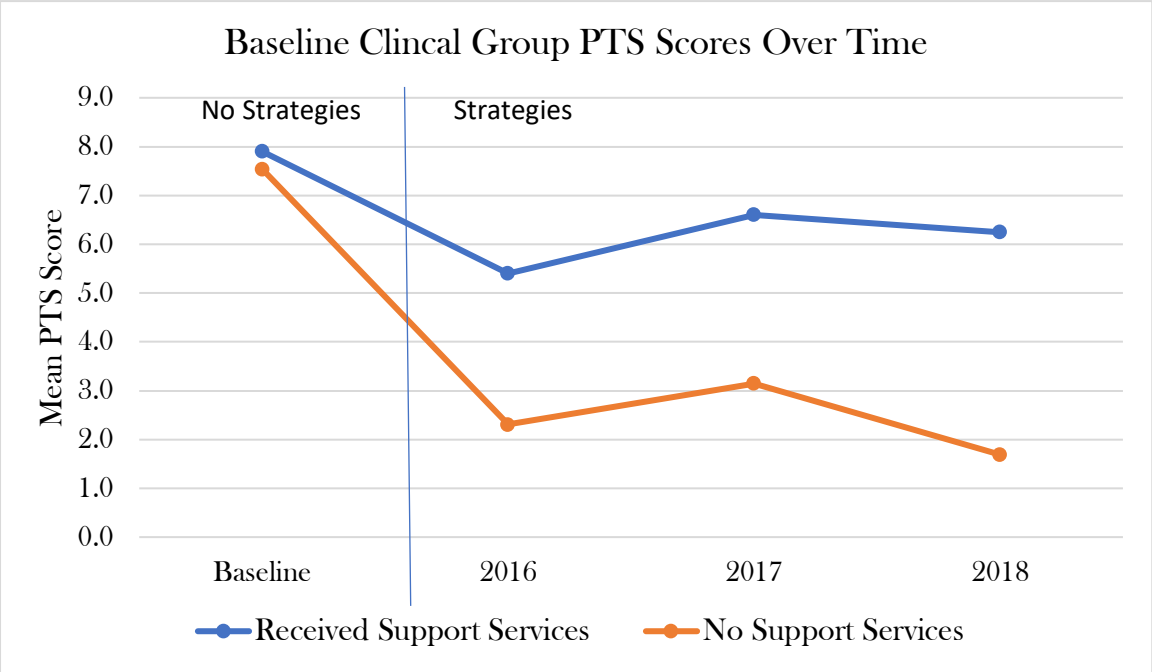

Figure 48 Effects of receiving any support services on Study 3 children with clinical PTS symptoms.

Overall, the analysis supports the strength of the strategies in producing positive change in children with clinical PTS symptoms, while traditional support services had effects that were difficult to identify.

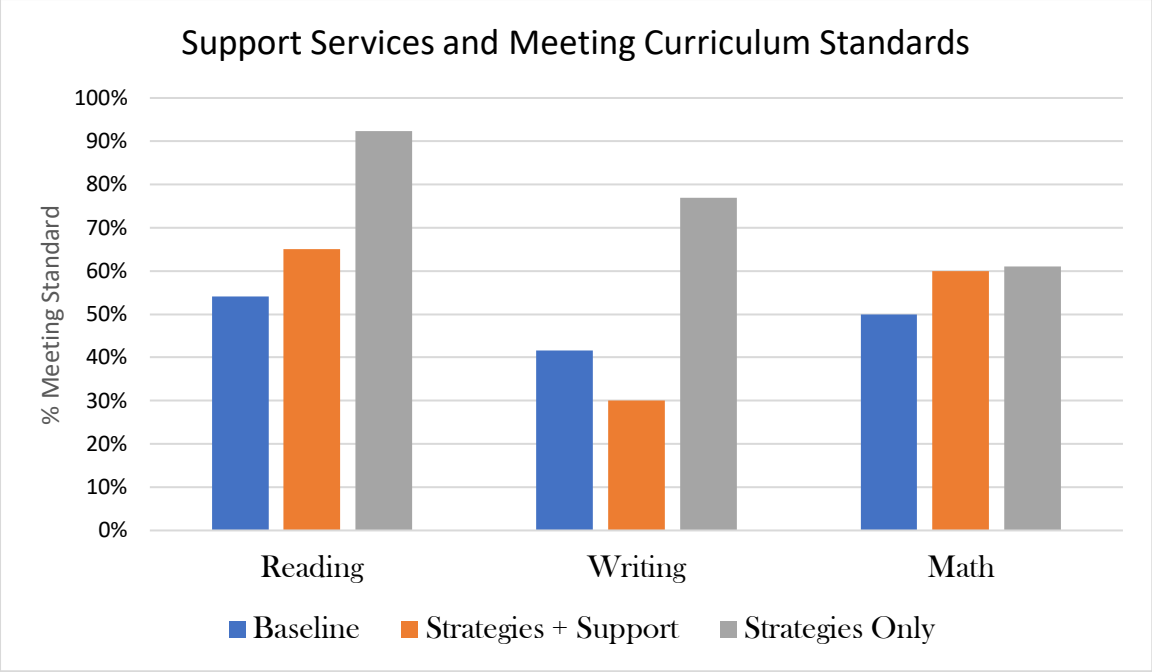

Figure 49 Contribution of any Support Services to baseline clinical children meeting curriculum standards

Contributions of Enrichment Activities

There was no statistical difference in changes to PTS symptoms within the clinical group by participation in enrichment activities (Figure 51). There were no significant differences in PTS scores, Self-Regulation scores or Attitude to Learning at baseline or the end of the project, according to participation in enrichment activities (70% had participated in enrichment). Although there were some differences in meeting national standards according to participating in enrichment (Figure 52), these differences did not reach statistical significance in the baseline clinical group. However, in the other children who did not have clinical PTS at baseline, participation in enrichment activities was associated with significantly more children meeting the standards in reading ($p<.001$), writing ($p<.001$), and maths ($p<.014$) as compared to children who did not participate.

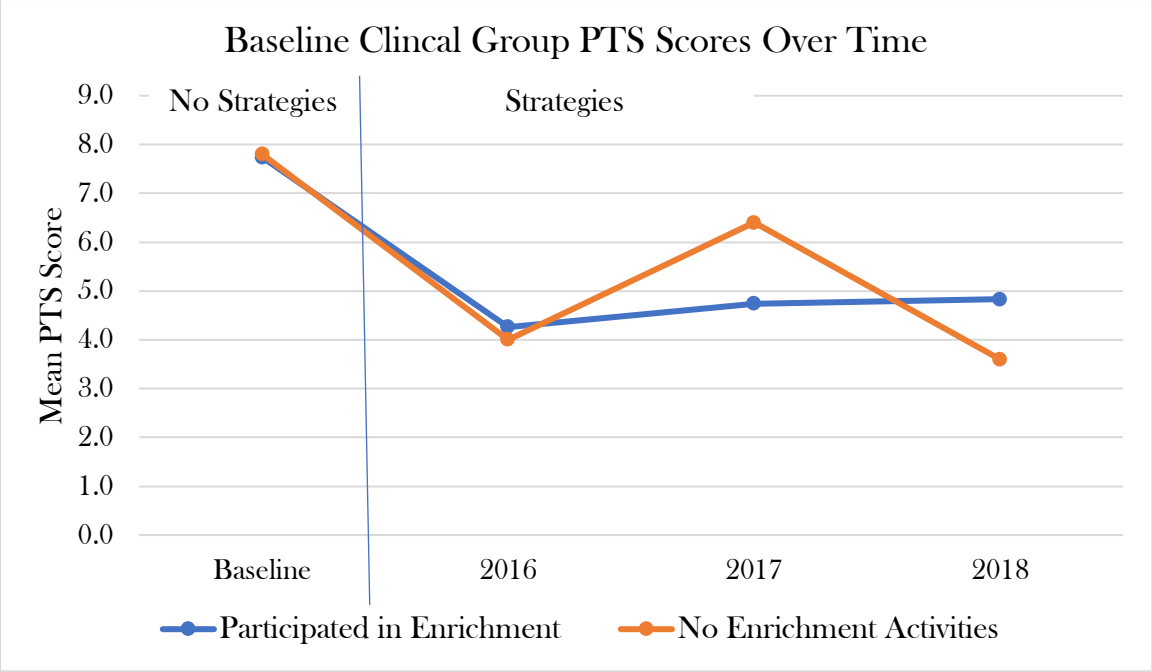

Figure 50 Effects of any enrichment activities on children with clinical PTS symptoms.

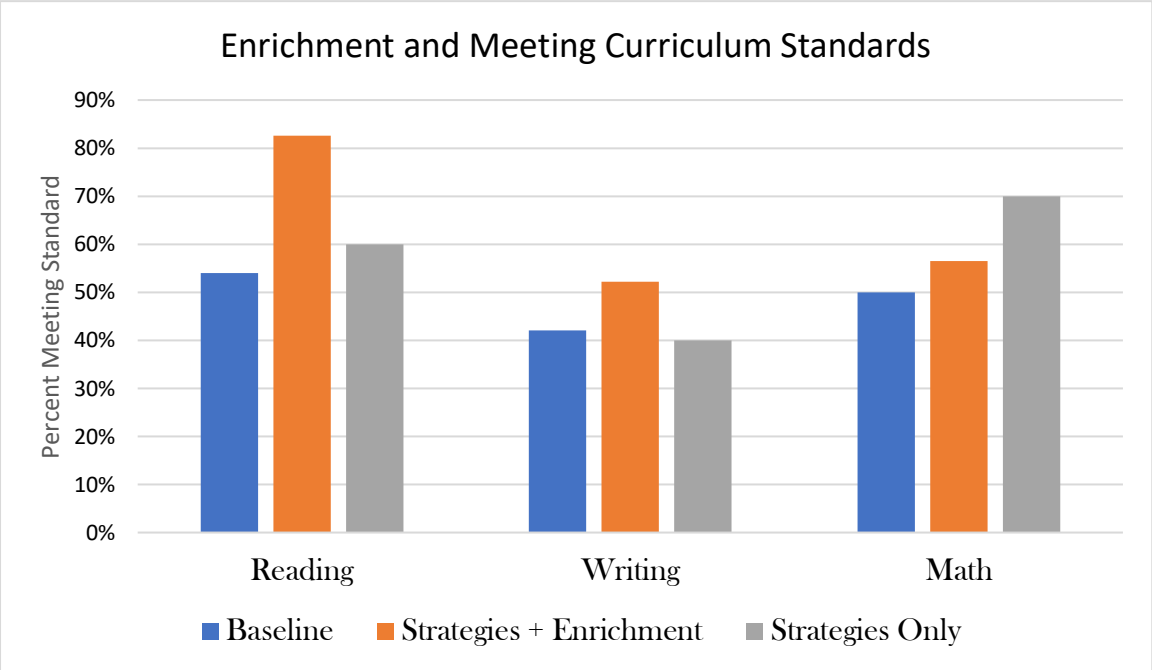

Figure 51 Effects of enrichment on meeting national standards in the baseline clinical group.

The improvements in PTS symptoms in the clinical group were independent of receiving support (e.g., counselling, RTLB) or participating in enrichment activities (e.g., Kapa Haka, music).

Receiving specialist support did not seem to improve meeting national standards in either the clinical group or the non-clinical PTS group. However, participation in enrichment activities contributed to improvement in rates of meeting national standards in the clinical group and the other children. The sample size in the original strategies group is too small to determine the relative contributions of strategies and enrichment to improvements in national standards, and information on these factors is not available from the replication study. Therefore, participation in enrichment activities may have also contributed to the improvement in learning, as well as attending schools implementing strategies over three years.

However, in the absence of other information, the effects of the strategies are not weakened and may be improved if children participate in enrichment activities (additional studies would need to be conducted if research was required to justify participation in enrichment activities as an activity funded by the school).

APPENDIX 4: RESULTS FOR INDIVIDUAL SCHOOLS, KINDERGARTENS AND PRESCHOOLS

Post-traumatic stress symptoms (mean and standard deviation SD) and the per cent of children with clinical-level symptoms in participating schools and kindergartens are shown in Tables 24 and 25. Related information for Preschools is shown in Table 26. This includes organisations that did and did not implement strategies. The results for participants have been anonymised and other information that may permit identification has been omitted. The principal, manager and/or head teacher has been given the identifying information only for their educational institution; additional details, including implementation intensity, participant demographic details and results for other outcomes can be requested via email from kathleen.liberty@canterbury.ac.nz.

Table 24 Post-traumatic stress symptom changes from Time 1 to Time 2 for individual schools in Study 3 and Study 4.

School Pseudonym	Post-traumatic Stress Symptoms		
	Measure	Time 1	Time 2
Henry Sewell	Mean (SD)	3.53 (3.10)	3.37 (3.22)
	% Clinical	30.8%	23.2%
William Fox	Mean (SD)	3.73 (3.21)	2.79 (3.01)
	% Clinical	29.%)	20.0 %
Edward Stafford	Mean (SD)	1.84 (2.59)	1.88 (2.63)
	% Clinical	12%	9.4%
Alfred Domett	Mean (SD)	2.49 (3.09)	1.73 (2.57)
	% Clinical	19.6%	7.5%
Frederick Whitaker	Mean (SD)	3.78 (2.92)	2.52 (2.64)
	% Clinical	28 %	17.5 %
Frederick Weld	Mean (SD)	2.31 (2.39)	n/a
	% Clinical	15.6%	
George Waterhouse	Mean (SD)	3.03 (3.44)	2.67 (3.3)
	% Clinical	24.3 %	16.7%
Julius Vogel	Mean (SD)	3.69 (3.08)	3.73 (3.06)
	% Clinical	27.1 (%	25 %
Daniel Pollen	Mean (SD)	3.75 (3.22)	3.03 (3.13)
	% Clinical	26.9%	17.2%
Harry Atkinson	Mean (SD)	2.46 (2.6)	1.03 (1.54)
	% Clinical	14.1%	1.7%
George Grey	Mean (SD)	1.50 (2.24)	3.00 (3.10)
	% Clinical	9.1%	22.2%
John Hall	Mean (SD)	3.4 (3.33)	2.89 (2.93)
	% Clinical	26.6 %	23.5%
Robert Stout	Mean (SD)	2.41 (2.65)	1.76 (2.49)
	% Clinical	14.2 %	12.9 %
John Ballance	Mean (SD)	2.5 (3.04)	2.40 (2.59)

School Pseudonym	Post-traumatic Stress Symptoms		
	Measure	Time 1	Time 2
	% Clinical	20 %	14.4%
Richard Seddon	Mean (SD)	2.89 (3.2)	n/a
	% Clinical	19.1%	
William Hall-Jones	Mean (SD)	2.93 (3.1)	2.93 (3.28)
	% Clinical	18.1%	20.8%
Joseph Ward	Mean (SD)	3.13 (2.97)	2.89 (2.58)
	% Clinical	25.0%	13.9%
Jim Bolger	Mean (SD)	3.94 (3.12)	n/a
	% Clinical	30.3%	

Table 25 Post-traumatic stress symptom changes from Time 1 to Time 2 for individual kindergartens in Study 4.

Kindergarten Pseudonym	Post-traumatic Stress Symptoms		
	Measure	Time 1	Time 2
Thomas Mackenzie	Mean (SD)	3.60 (3.72)	1.77 (3.32)
	% Clinical	30.0%	15.4%
William Massey	Mean (SD)	0.18 (.40)	0.13 (0.52)
	% Clinical	0%	0%
Francis Bell	Mean (SD)	1.17 (1.47)	0.33 (0.82)
	% Clinical	0%	0%
Joseph Coates	Mean (SD)	4.00 (2.45)	(one child)
	% Clinical	20%	(one child)
George Forbes	Mean (SD)	0.41 (1.00)	0.00 (.00)
	% Clinical	0%	0%
Michael Savage	Mean (SD)	3.65 (3.22)	2.00 (2.26)
	% Clinical	35%	5.9%

Table 26 Resilience score changes Time 1 to Time 2 for individual preschools in Study 4.

Preschool Pseudonym	Resilience		
	Measure	Time 1	Time 2
Peter Fraser	Mean (SD)	3.20 (.92)	3.60 (.73)
	% Low	52.6%	20.0%
Sidney Holland	Mean (SD)	3.53 (1.17)	3.88 (1.23)
	% Low	50%	20%
Keith Holyoake	Mean (SD)	3.24 (.95)	3.96 (.94)
	% Low	33.3%	22.2%
Walter Nash	Mean (SD)	3.89 (.86)	3.73 (.51)
	% Low	76.2%	7.7%
Jack Marshall	Mean (SD)	3.50 (1.31)	4.05 (1.04)
	% Low	50%	20.0%
Norman Kirk	Mean (SD)	3.25 (.59)	3.46 (.75)
	% Low	50%	16.7%
Hugh Watt	Mean (SD)	3.79 (.95)	3.81 (.95)
	% Low	27.8%	16.7%
Bill Rowling	Mean (SD)	2.51 (1.03)	3.41 (1.13)

Preschool Pseudonym	Resilience		
	Measure	Time 1	Time 2
	% Low	76.2%	38.1%
Robert Muldoon	Mean (SD)	2.94 (.93)	3.48 (.68)
	% Low	64.0%	18.2%
David Lange	Mean (SD)	3.15 (.60)	4.03 (.84)
	% Low	46.2%	8.3%
Geoffrey Palmer	Mean (SD)	3.49 (1.25)	4.11 (.79)
	% Low	35.0%	10.0%
Mike Moore	Mean (SD)	3.58 (.69)	3.61 (.88)
	% Low	10%	33.3%

APPENDIX *5*: RELATED RESEARCH: MASTERS THESES

2018 (ongoing). Chao Gu. [Title Here, up to 12 Words, on One to Two Lines]. MA (Child and Family Psychology). Supervisors: Kathleen Liberty and Karyn France.

2018 (ongoing). Kirsty Robinson. Mental Health and Wellbeing in Christchurch Adolescents: Dual Model of Mental Health. MA (Child and Family Psychology). Supervisors: Kathleen Liberty, Sue Bagshaw, Ria Schroeder.

2018 (ongoing). Rachel Davis. A Self-Determination Intervention for the Promotion of Positive Coping for Youth Offenders: A Pilot Study. MSc (Child and Family Psychology). Supervisors: Kathleen Liberty, Michael Tarren-Sweeney, Mike Steele.

2018 (ongoing). Lee Hooper. Provisional title: An evaluation of a novel intervention for the physiological and psychological regulation of primary school children with chronic stress symptoms. Ph.D. (Health Sciences). Supervisors: Kathleen Liberty, Michael Tarren-Sweeney, Mike Steele.

2018. Filip Piri. The effect of colouring-in tasks on heart rate and classroom behaviour: An in-depth single-subject study. MSc (Child and Family Psychology). Co-Supervision: Lawrence Walker and Kathleen Liberty

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2017. Clare Vesty. *The effects of a simulated nature experience on the physiological and behavioural responses of young children with post-traumatic stress symptoms.* MSc (Child and Family Psychology). Supervisors: Kathleen Liberty, Lawrence Walker.

2017. Jade Adams. The Effect of Drawing Lessons on Hyperarousal in Children who Experienced the Canterbury Earthquakes. MSc (Child and Family Psychology). Supervisors: Kathleen Liberty, Lawrence Walker.

2015. Megan Ryan. The effects of the Christchurch Earthquakes of 2010 and 2011 on the Quality of Life of Children and Adolescents with Disabilities. MHealSc. Supervisors: Kathleen Liberty and Ray Kirk.

2015. Solfrid Gillman. Young children's experiences of coping four years after the Christchurch Earthquakes. MA (Child and Family Psychology). Supervisors: Kathleen Liberty, Michael Tarren-Sweeney.

2014. Tara Mueller. The effects of a combined conflict resolution-mindfulness intervention on the positive peer interactions of primary school-aged children. MA (Child and Family Psychology). Supervisors: Kathleen Liberty, Neville Blampied.

2013. Annabel Carter. Helping, caring and learning: Strengths in New Entrants Settling Into and Learning in Primary School in Post-Earthquake Christchurch. MA (Child and Family Psychology). Supervisors: Kathleen Liberty and Sonja Macfarlane.

2013. Aleksandra Gosteva. Effects of early childhood teacher-delivered play therapy intervention on the social skills of young children: A Pilot Study. MHealSc (Early Intervention). Supervisors: Kathleen Liberty and Judi Miller.

NOTES

[1] As the results for previous years showed that the results for behaviour problems, anxiety and depression, and post-traumatic stress symptoms produced identical patterns of change, and to reduce the overall length of this report, only Post-traumatic Stress Symptoms are reported in this present report.

[2] Percent per school calculated from school roll statistics on 1 July 2018, Ministry of Education, and applied to study children for each school, creating a weighted average. The first value is for all 12 schools, and the second value, in parentheses is for 8 schools which implemenented the strategies.

[3] Average rating on self-regulation items= not like, not at all like (2.9 and below).

[4] Very low self-regulation on Circle of Well-Being (Below 11 on scale of 4-20).

[5] For more information on the sleep education, kindness, and positive coping programmes, please visit: https://bromtreeinquiry.com/yes-i-can/.

[6] Calculated from Table 1 (Minassian, Najarian, & Steinberg, 1997)., all participants. Treated, N=35, M=45.3 (SD=11.0). Untreated, N=29, M=41.1, (SD=9.0),

[7] Self-regulation in baseline clinical group. No support, Mean=3.91, S.51; Support: Mean = 2.71, SD=.88; F=18.929, p<.000. Attitude to learning in baseline clinical group. No support, Mean =4.256, SD=.50; support= 3.39, sd=1.21, F= 5.807, p=.023).